

GEOLOGICAL REPORT
ON THE
Stannary Hills Mines
BY
Dr. R. LOGAN JACK, F.G.S.

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ON

THE PROPERTIES

OF THE

**STANNARY HILLS MINES AND
TRAMWAY COMPANY,
LIMITED,**

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**STANNARY HILLS AND WATSONVILLE,
NORTH QUEENSLAND.**

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(late Government Geologist of Queensland).

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Report on the Stannary Hills Company's Mines

To the Directors of the Stannary Hills Mines and Tramway Company, Limited.

Gentlemen—

The following pages, together with plans Nos. 1 to 18, embody the observations which I have been able to make during a stay extending from 15th November to this date.

I take this opportunity of recording my acknowledgments for valuable assistance and information given by Mr. Chas. E. Nicholas (General Manager), Mr. George B. Hope (Mine Surveyor), Mr. Victor G. Martin (Assayer), Messrs. J. K. Campbell and E. Murdoch (Mine Managers), and, indeed, by all the officers of the Company.

KITCHENER.

(See Plans Nos. 1, 2, 3, and 4.)

This Mine is in Lease No. 1404, and is worked from a main shaft on the top of a hill and a tunnel driven north-eastward from the right bank of Eureka Creek. The tunnel is connected by a short branch line with the main tramline, which it leaves near the 13 $\frac{1}{4}$ mile post.

The following are vertical measurements :—

Main Shaft (brace)	0 feet.
No. 1 Level	105 "
No. 2 Level	178 "
Tunnel Level	274 "

On the hilltop, in the vicinity of the shaft, the rocks are soft and ferruginous, and can be recognised as weathered forms of the "chlorite rock" of the district—an alteration-product of the more felspathic varieties of sandstone.

At No. 1 Level a drive goes east for 43 feet through sandstone, which occurs in beds, striking N. 32° W. and dipping at 70° to 75° to E. 32° N. Nine feet from the centre of the shaft the sandstone is cut by a seam running N. 13° W., and underlying at a steep angle to E. 13° N. Beyond this seam the roof of the drive shows an almost continuous band of pyritous chlorite ore. Seventeen and thirty-four feet from the shaft, crosscuts to S.S.E., measuring respectively 10 and 16 feet in length, lead to the edge of **No. 1 stope**. This stope is on a pipe of ore 35 feet N.W. and S.E., and 20 feet S.W. and N.E., which has been taken out up to the surface and down to and below No. 2 Level. Twenty feet below, No. 1 stope has nearly the same shape as in No. 1 Level, but its north-eastern boundary line shows a steep underlie to the south-west.

At No. 2 Level, the western end of the ore body represented by "No. 1 Stope," is almost directly beneath the eastern corner of the stope in No. 1 Level. The body extends eastward for 66 feet, with an average width of 11 feet. Its upper surface rises from its eastern extremity, and is continuous with the body which has been excavated from the surface downwards to about 20 feet above No. 2 Level. The stope has been continued for 50 feet below No. 2 Level, and the ore passed down by a winze to the "Kitchener Branch" of the tunnel. In No. 2 Level this ore body is seen to be bounded on the east by a fault running nearly N.N.W. and underlying steeply to the east. This fault divides it from the ore body of No. 2 stope. The two bodies are, in fact, continuous, one on each side of the fault. From No. 1 stope 4,677 tons of stone have been crushed for an average of 3.4 % of tin oxide (70 %) from September, 1903, to November, 1906, inclusive.

A drive to the east leaves the eastern corner of No. 1 stope at the 125 feet level. In 34 feet it meets with a 1-in. N.N.W. vein of zinc-blende and pyrites in the roof, dipping at a low angle to the E.N.E. (no doubt identical with the N.N.W. fault of the preceding paragraph). From this vein the level for the next 45 feet passes through "ore" consisting of chloritised sandstone with streaks of pyrites and a little tin, too poor to crush. (Zinc-blende was observed in a short crosscut to the north-west.) At the end of the 45 feet reach, the ore has improved in quality up to payable grade, and **No. 2 Stope** begins. Here a winze has been sunk 43 feet, into the roof of the stope, as worked up from 213 feet. From this winze an opening on the stope is accessible at the 160 feet level. Here the payable

ore has been approximately 30 feet long from W. to E. and 18 feet wide from N. to S., and from this floor the ore has been stoped up to 125 feet.

From the S.E. corner of this pipe-like excavation at the level of 145 feet, a drive goes 50 feet E.S.E. through "ore" of a character similar to that in the western side of the payable ore body. At the face of the drive is a seam running N.N.W. and underlying to E.N.E. at 45 degrees. South of the end of the drive a chamber 16 feet wide has been opened out in ore, and in it a winze has been sunk 27 feet (i.e., to 172 feet). The bottom is in 6 or 7 per cent. ore.

That the ore body of No. 2 stope is only separated from that of No. 1 stope by a line of fault has already been mentioned.

At 213 feet the **No. 2 Stope** (sometimes called the "Main" Stope) has yielded payable ore for 70 feet from west to east, and of a width varying from 14 feet at the fault to 30 feet near its eastern extremity. In other words, at this level the long stretch of ore too poor to work (except for a length of 30 feet) at the 125 and 145 feet levels, has improved at 213 feet to a wide body of payable ore 70 feet in length. It has been stoped up to 168 feet, the roof of the stope having, as already mentioned, been broken into by the 43 feet winze from the 125 feet level.

The dimensions of this stope at the lowest point to which it has reached, viz., 229 feet, or 45 feet above the tunnel level, are 46 feet from west to east, and an average of 10 feet from north to south. Here it yields 4 per cent. ore, which is passed down a chute to the tunnel. At the eastern extremity it is comparatively poor, but is worth driving on as far as ore extends in the hope of improvement. In the chute I was informed there was rich ore 12 feet above the tunnel.

In the "Kitchener Branch" of the tunnel the same ore body, mined in what are called the "Tunnel Stopes," extends about 26 feet west and 34 feet east of the last-mentioned chute. The ore is a pyritous chlorite. Between the chute and a north and south fault which forms its western boundary it is of low grade, but east of the chute it has been worked to a width of 16 or 18 feet, and to a height of about 20 feet above the tunnel. The ore in the roof here averages about 1.8 %.

The 26 feet of poor ore in the tunnel west of the chute represents what was good ore above, and there may be good ore below it, just as the long stretch of poor ore at 125 to 145 feet became a long stretch of good ore at 168 feet.

No. 2 stope has crushed up to the end of November, 1906, 8,713 tons for an average of 2.6 % tin oxide (70 %).

There can be no question of the continuity of the ore body in the tunnel stope with that in the No. 2 or main stope, and the application of different names to the ore bodies of No. 2 and No. 1 stopes is merely a matter of convenience, the two bodies being contiguous, and practically one and the same.

I do not think that the whole horizontal lengths of the shoot of ore (payable and non-payable) has yet been proved in the tunnel level, although the level has been continued for 25 feet past the "Tunnel Stopes" in blank ground (sandstone) for 25 feet, with the exception of a mineralised seam running N.W. and S.E., 2 feet short of the face. **The continuation of this tunnel is desirable.**

The "Kitchener Branch" leaves the main tunnel 30 feet south-west of the Main Shaft, and follows a sinuous course to the east. Its eastern portion, beyond the "north and south fault" which bounds the No. 2 ore body on the west, has already been described.

This fault runs, to be exact, N. 15° W. and underlies at 70° to E. 15° N. Thence west to the Main Tunnel, there is little change in the rock, which is a fine-grained hard semi-crystalline sandstone, dipping at 70 degrees to E. 17° N.

Reckoning westward from the fault; from 7 feet to 16 feet, the sandstone on the north side of the tunnel is chloritised and pyritous. Twenty-six feet from the fault another fault runs N. 12° W. and underlies steeply to E. 12° N. It has been followed in crosscuts on both sides of the tunnel for an aggregate length of 54 feet, with the result of finding a patch of 2 per cent. chlorite ore on its western or footwall side in the north crosscut. In all probability this is the same fault which divides, at No. 2 level, the ore body worked in No. 1 stope from that worked in No. 2 stope, and it would be worth while to follow the patch of ore up.

West of the crosscut, at distances of 8 and 21 feet respectively, faults approximately parallel with that in the crosscut itself are met with.

Thirty-five feet from the fault in the crosscut a drive has been made to the north for 30 feet. Ten feet short of the face a seam, running E. 22° N. and underlying at 80° to S. 22° E., carries pyrites and a little tin. This drive has stopped short, by a few feet, of **proving** that the ore body in No. 1 stope does not come down to the level of the tunnel, although it is almost a certainty that the bottom of the ore body abuts, above the tunnel level, against the fault which, at No. 2 level, separates No. 1 ore body from No. 2.

Immediately west of the north drive another seam or fault crosses the tunnel on a course of N. 20° W., underlying at a steep angle to E. 20° N.

Twenty feet further west, at the chute from the No. 1 stope, a band of felspathic sandstone may be observed, compressed and chloritised, and running nearly north and south. This compressed and chloritised condition is regarded in this district as favorable to the production of tin ore.

Twenty-six feet east of the junction of the "Branch" with the "Main" Tunnel, a seam runs N. 28° W., and underlies at a high angle to E. 28° N. Ten feet east of the junction a vein of pyritous chlorite ore runs N. 25° E. and underlies to W. 25° N.

In No. 2 Level, the No. 1 ore-body is reached by a crosscut from the shaft, driven 35 feet to S. 30° E., along the strike of the sandstone beds, which dip to E. 30° N. at 75 degrees. The line of No. 1 ore body is prolonged across this crosscut by a vertical seam running west. South of this seam the crosscut is carried for a few feet on a vertical seam in the lines of bedding. Midway between the shaft and No. 1 stope a short drive to the east discovers 18 inches of pyritous ore, which has been followed upward for 12 feet.

On the No. 1 Level a crosscut goes N.N.W. for 18 feet from the western end of the shaft and S.S.E. for the same distance, following the strike of sandstones with partings of shale, which dip at 75 degrees to E. 8° N. From the northern extremity of this crosscut the "West Drive," now thirty feet in length, is being carried to the west on a vein of pyritous ore, 1 to 3 feet in thickness. About midway 2 per cent. ore was going underfoot. At 30 feet, where I saw it last, the quality of the ore seemed to be improving. Just as I am leaving the place I learn that at 40 feet the vein has abutted on a head running north-east, with solid ore behind it. The face assays 2.6, and the drillings 2.9 per cent. of tin oxide. This is the most important development which has taken place in the "Kitchener" for some time. It proves the existence of a body of good ore 105 feet below the gossamy chlorite outcrop seen at the surface behind the engine shed. That the last-mentioned ore body was only superficial might easily have been inferred from the absence of a corresponding body in the trunk line of the Extended Tunnel and the Extended Branch Tunnel; in fact, these two tunnels seem to have just missed a valuable shoot of ore going down in the angle between them, the shoot in question forming the connecting link between the Kitchener and Extended Mines.

The S.S.E. end of the crosscut is prolonged for 30 feet to the south, evidently with the object of making certain that No. 1 ore body had really come to an end about ten feet to the east. Nothing but country rock was met with, except for a vertical vein in the roof which was followed for a few feet W.S.W.

Mr. Hope estimates the ore reserves developed at the present date in the No. 2 stope as follows :—

Between No. 1 and No. 2 Levels	2,550 tons.
Between No. 2 and Tunnel Levels	710 "
Total	3,260 tons.

Estimated to contain 2.6 per cent. of 70 per cent. oxide.

EXTENDED.

(See Plans Nos. 1, 4, 5, 6, and 7.)

The Extended Shaft (at one time known as "Bobs") is 185 feet W. 22° N. of the Kitchener, and commences at a level 43 feet higher. The winding engine is little used except for the transport of tools between the workings and the smithy, the winding of ore being obviated by its passage through chutes to the "Extended Branch" of the tunnel.

The following are vertical measurements :—

Brace of Shaft	0
No. 1 Level	70
No. 2 Level	125
No. 3 Level	186

Engine Level	..	..	..	..	..	..	..	274
Tunnel Level	..	..	..	..	..	..	..	317
Bottom of so-called "Main Shaft"	..	..	..	..	..	..	..	326
Bottom of winze from Tunnel	..	..	..	..	..	..	..	360

No. 1 Level (70 feet) commences at the shaft, and for the first 45 feet runs due west through sandstones which dip at 80 degrees to E. 40° N. From 22 to 36 feet stopes extend along the level, and these have been worked to the south on oxidised ore up to the surface on the summit of the hill. From the stopes to the western end of this reach of the level a seam containing oxidised ore is seen in the roof.

The level then turns north-west and follows, for 35 feet, a vein of pyritous chlorite ore up to one foot in thickness. It is oxidised and kaolinised, and dips to the north-east at 55 degrees. It has been stopped up to the south-west for a few feet in two places.

The level is again deflected to the west for the last forty feet. At thirteen feet a winze is sunk to the 125 feet level, and from this winze (at 70 feet) a crosscut to the south traverses oxidised ferruginous chlorite ore or thirteen feet, when it encounters a wall—probably a line of fault—beyond which is sandstone. The last 25 feet of this level to the west follows a kaolinised ferruginous seam dipping at a high angle to the north.

No. 2 (125 feet) Level is intersected at 35 feet by a crosscut driven 93 feet south-west from the shaft through hard sandstone. In this crosscut a pyritous seam (a) is met with at 17 feet, running north 12° west and underlying steeply to E. 12° N. A second seam (b) is met with at 31 feet, running N. 19° W. and underlying steeply to W. 19° S. A third seam or vein (c), three feet further to the south-west, is parallel to (b), but underlies in the opposite direction, so that the two seams must intersect or coalesce a few feet below the crosscut. Another seam (d), our feet further S.W., is parallel with (b) and (c), but vertical. Fifty feet from the shaft a pyritous vein (e) runs five degrees north of west, and underlies at 80 degrees to west 5 degrees south. Sixty-eight feet from the shaft a pyritous vein (f) runs west 14 degrees north, and underlies at 25 degrees to north 14° east.

The No. 2 level itself has been opened on seams b, c, and d on a general course of N. 20° W. and S. 20° E. Vein (e), first seen in the crosscut, crosses the level 30 feet N.N.W. of the latter. Veins c and d are traceable N.N.W. along the level till they abut against vein e. Followed along the level from the crosscut in the opposite direction (viz., S.S.E.), vein c dies out, while veins b and d come together in fifteen feet, and are continued as a thin lode, with at first a steep underlie to E.N.E. Forty-five feet from the crosscut, the lode, consisting of crushed chloritic matter with threads of pyrites, has thickened till it occupies the whole width of the level, and is vertical. It preserves this width almost to the end of the level (150 feet S. 20° E. of the crosscut). It underlies to W.S.W. at 65 feet, is vertical at 80 feet, and underlies to E.N.E. at 120 feet, and, in fact, is practically vertical throughout, with slight local leanings to one side or the other.

This long lode, although apparently too poor to work at the 125 feet level, calls for further attention, for the following reasons:—

- (1) It is almost certainly the prolongation of "Shanahan's Lode" which, at the 144 feet level, was very good indeed.
- (2) It is exposed in No. 2 level in virgin ground, no workings having been carried on either above or below, unless, indeed, the ore in the bottom of the shallow "Khalifa" shaft may be held to represent it. There is plenty of room both above (125 feet) and below (192 feet to the Tunnel Level) for "poor ore" to become "payable ore," as has so often been the case in the history of these mines.

It may be conjectured that this lode is represented by the vein which crosses the Extended Tunnel 534 feet from the entrance.

Returning to the crosscut and continuing along the 125 feet level to N.N.W. shortly beyond vein e, pyritous ore begins to appear in the roof. Fifty-three feet from the crosscut a winze has been commenced from the floor of the level. From this winze, for 40 feet (to winze A) the level turns to the N.W. following the ore. Over the greater part of this distance stopes rise to the west for about 20 feet to the winze already referred to as coming down from the 70 feet to the 125 feet level. The stopes are 10 feet wide in places. Winze A goes down from No. 2 to No. 3 (186 feet) Level. For the first 25 feet it goes vertically down in a large pipe from which good ore was extracted. It then opens out into large stopes which were carried up from No. 3 level.

From the end of the up-stopess beyond winze A a branch of the main 125 feet level

or drive goes for 20 feet to N. 25° W. along the strike of sandstones and shales, which dip at 60 degrees to E. 25° N. The motive of this drive is to follow a brecciated vein coinciding with the bedding-planes of a band of shales. The vein contains some tin ore, one assay having given 2 per cent.

From the point where this drive leaves it, the main No. 2 Level is carried for 90 feet, on an average, if somewhat sinuous, course of N. 20° E. This portion of the level is directly above the large stopes on "Shanahan's Lode" and the immense ore body which has been stoped out east and west of "Shanahan's."

At the bifurcation of the drive and main 125 feet level, a seam—probably a fault—intersects the country rock. At this point it has a steep underlie to the west. It is probably identical with the vertical head which carries a veinlet of quartz and forms the western wall of the main level from a point forty feet to a point sixty-three feet from the "bifurcation." In the roof of the level, from the "bifurcation" to the face, a dark chlorite ore, with threads of pyrites and veinlets of quartz, is visible for the greater part of the distance. Twelve feet from the "bifurcation" a crosscut is now in 25 feet to the east, and has cut lode matter for the first 6 feet, the remainder being in sandstone, with the exception of a 6-inch north and south vein of quartz (underlying to the west) at fifteen feet, and an 8-inch north and south vein of quartz and pyrites at 20 feet. Another crosscut from the main level, 50 feet from the "bifurcation," goes 10 feet to the S.E. and cuts 8 feet of black chlorite ore with pyrites, ending in a 2 feet vertical north and south vein, mainly of quartz and pyrites. The remaining distance of 2 feet is in sandstone. Both of these crosscuts are being driven further.

Thirty feet short of the face of the Main Level a vertical vein of quartz, one inch in thickness, runs nearly north and south, crossing the level. Opposite this a short crosscut proves the pyritous ore to extend to 3 feet to the west before sandstone is met with. Another north and south quartz veinlet is seen on the E.S.E. side of the level about 12 feet from the face.

No. 3 Level (186 feet) starts direct from the shaft, going W. 44° N. for the first 40 feet, and next N. 22° W. for 38 feet, through hard crystalline sandstone, striking W. 43° N. and dipping S. 43° W. at a high angle. Twenty feet from the shaft, a fault is met with, containing in places an attrition-breccia seamed with pyrites. As it is followed to the end of the W. 44° N. stretch of the level, it is seen to be, on the whole, vertical, although locally it hades a little to N.E. or S.W. This, which for the sake of distinction may be called the "first" fault, is shifted 2 feet to the east, at the end of the W. 44° N. stretch, by an east and west fault, which may be designated the "second," and which underlies steeply to the north. From the second fault the first fault is traced a little to the west of the north for sixty feet, having at first a steep underlie to the east, and in its northern part a steep underlie to the west. The level drops 6 feet at the second fault, viz., to 192 feet, to which depth a lode ("Shanahan's") has been excavated to a width of 7 feet east of the first fault. Shanahan's lode has been worked for a further distance of 90 feet to the north, varying in width from 14 to 7 feet at the 144 feet level. Near the second fault Shanahan's has been stoped up to the 125 feet level at winze A.

East of Shanahan's, from the second fault, and for 60 feet to the north, a mass of ore has been stoped out at the 186 feet level, and nearly up to No. 2 level. At 192 feet it is 15 to 20 feet in width.

The sandstone on the western side of the first fault having been cut through opposite the northern end of the last-mentioned stope, a third fault is met with four feet from the first, with which it is nearly parallel. The third fault underlies to the west. Between the first and third faults, the mass of sandstone country increases in breadth southward, and narrows and probably pinches out to the north, where the two faults and the formation between them become "Shanahan's Lode."

West of the third fault, as seen at the 192 feet level, an immense body of ore has been stoped out, rising southward with the rise of the second fault, to No. 2 level at winze A. At 192 feet this stope is 60 feet from north to south and 10 to 25 feet from east to west.

At the **240 Feet Level** the excavation on the last-mentioned ore body can be seen. The "third" fault of the 192 feet level still forms its eastern boundary, and good ore has been taken out for sixty feet from north to south, and for 15 feet from east to west. On the western side, low-grade, dark pyritous chlorite ore has been left unworked. This working is a little to the north of the working on the same ore body at 192 feet, showing that the dip of the shoot of ore is still to the north. At both ends of the 240 feet excavation the line of the "third" fault is followed for a few feet on a lode-breccia with quartz. In the

northern drive, 25 feet in length, this lode matter is 3 feet in width. The "third" fault underlies to the west, and the ore body on its hanging wall side dips to the north.

The **Engine Level** (274 feet) was not accessible, but the same orebody has been stoped down to it.

In the **Tunnel Level** ("**Extended Branch**"), 317 feet, the same shoot of ore is met with still further to the north than at 240 feet. It has been taken out for 35 feet from north to south, and an average of 20 feet from east to west. The "third" fault of No. 3 level, underlying to the west, still forms the eastern boundary of the ore body, which has been stoped out about 25 feet above and 12 feet below the tunnel level. At the northern end of the excavation the fault is seen splitting into two—the western branch forming the hanging wall, and the southern branch the footwall of an "attrition-breccia," or lode formation, which occupies the full width of a drive carried 65 feet to the north. This "formation" contains traces of tin, and near the face of the drive shows galena and pyrites.

From the excavation at the tunnel level the so-called "main" shaft has been sunk 12 feet, and a winze has been sunk 100 feet on the eastern or footwall side of the lode.

The "first" and "third" faults of No. 3 level are the dominant factors concerned in the future of the mine. These faults **become** Shanahan's lode, and from them have **emanated** the ore which has impregnated and partly replaced the country rock, to form the large ore bodies to east and west. The Extended Mine is "Shanahan's" lode, with lateral bonanzas leaking out from it. It will be gathered from the above description that Shanahan's is going strong to the north in the 240 and 370 feet levels, and to the south in the 125 feet level. These may at any time become payable ore bodies, or send out fingers to east or west. In no scheme of prospecting should their importance ever be lost sight of.

The Extended Shaft is in the middle of a large area covered by an outcrop of a ferruginous chlorite, containing tin, which has been prospected by many old trenches and shallow shafts. Old dumps containing 2,300 tons of ore, are lying at grass ready to be passed down to the tunnel. They assay from 0.3 to 3.6 per cent. of tin oxide, and average over 1 per cent.

From October, 1903, to November, 1906 (inclusive), the Extended Mine has crushed 14,898 tons of ore averaging 3.95 per cent. of tin oxide (70 %).

TUNNELS.

(See Plans Nos. 1 and 4.)

The "Kitchener Branch" has already been described, as it was convenient to refer to it in connection with that mine.

The "**Extended Branch**," 187 feet from where it leaves the main tunnel, throws out what may be called the "**North West Fork**," 140 feet to the winze sunk 100 feet below the tunnel. The whole of the North West Fork is in hard crystalline sandstone. Five feet S.E. of the winze a N. and S. fault is seen underlying to the west. Nine feet from the winze is the "first fault" of No. 3 level. Forty-four feet from the winze a vein or seam of dark siliceous and chloritic lode matter, containing pyrites, runs W. 42° S. and underlies steeply to N. 42° W. Seventy feet from the winze two smooth black seams cross the tunnel from west 23° N. to E. 23° S., and underlie steeply to N. 23° E. It is just possible that these seams may represent the "second fault" of No. 3 level.

The N. 22° W. Fork of the "Extended Branch" of the tunnel is carried in that direction for 123 feet from the survey peg in the roof near the bifurcation. The measurements given are from the peg.

The "fork" is driven on the strike of the country rock. Beds of shale occur between the sandstone beds and the strata dip to E. 22° N. at angles varying from 45 to 50 degrees.

Twenty feet from the peg, the walls of the tunnel are formed by two seams underlying at steep angles to E. 22° N. Fifty feet from the peg (just beyond the chute from the 186 feet level of the Extended), a band of shale has been found to contain traces of tin. From 70 to 109 feet from the peg, the S.W. side of the tunnel is defined by a fault (in a bed of shale) underlying at a steep angle to E. 22° N. At its further extremity this fault is cut off (or shifted out of the tunnel) by a vertical fault running N. 35° E. Beyond the fault for 13 feet (to the face), the whole of the level is occupied exclusively by beds of shale, the strata on the opposite side of the fault being mainly sandstone.

"Extended Branch."—From the peg at the bifurcation the Extended Branch goes

S. 23° E. for 187 feet, when it strikes the "Extended Tunnel" (the trunk line). It keeps the strike of the strata, which consist of alternations of hard, mainly siliceous, sandstones and shales, and dip to E. 23° N. at 80 degrees.

Immediately beyond the peg already mentioned, a vertical seam or fault runs N. 7° E. It is probably identical with the seam which forms the eastern wall of the "N. 22° W. Fork." It contains some tin. Thirty feet from the peg another vertical seam, also containing tin, runs E. 38° N. Commencing 93 feet from the peg, two seams or faults occur on the E.N.E. and W.S.W. sides respectively of the tunnel, both having a steep underlie to E.N.E. The one on the E.N.E. side is only traceable for 17 feet. The other can be followed for 60 feet, and contains an attrition breccia in the middle of a band of shale. It carries a little tin. One hundred and fifty feet from the peg, a 6-inch vein is seen on the E.N.E. side of the branch tunnel. It is traceable in the roof for 43 feet to S. 12° E. till it crosses the trunk tunnel and underlies at a steep angle to E. 12° S.

Trunk Tunnel.—On a course of E 28° 30' N. the Trunk Tunnel goes 98 feet beyond the "Extended Branch" through massive sandstone; at 44 feet the "Kitchener Branch" strikes off to the right, and at 76 feet the Kitchener Shaft is passed on the same side.

In the opposite direction, viz. to W. 28° 30' S. the mouth of the Trunk Tunnel is 611 feet distant from the "Extended Branch." In the whole distance there is little variation in the rock, which consists of a thick-bedded, fine-grained sandstone, dipping steeply to E. 38° N., partly siliceous and partly felspathic, the felspar having a tendency to crystallization. At 341 and 529 feet from the "Extended Branch," exceptions to the general rule, in the shape of beds of shale, were noted.

Reckoning from the "Extended Branch" towards the mouth of the tunnel the following were noted :—

At 22 feet, seam N. 23° W. Steep underlie to W. 23° S.

At 50 feet, seam W. 7° S. Steep underlie to S. 7° E. This is the seam which has already been mentioned as probably representing the lode (the continuation of "Shanahan's") occurring in the southern portion of No. 1 level.

At 75 feet, vein S. 12° W. Steep underlie to W. 12° N.

At 93 feet, seam, S. 12° E. Steep underlie to W. 12° S.

At 115 feet, seam, N. 11° E. Steep underlie W. 11° N.

From 174 to 184 feet, 3° N. and S. seams or veins, underlying steeply to west.

At 201 feet, a 1-inch vein, with a film of quartz, runs E. 33° S. Steep underlie to N. 33° E. A crosscut has been driven on this vein. In 15 feet a 6-inch vein of chlorite, with quartz and a little tin, was met with. It was followed on the level for about 23 feet, to W. 28° S., but without satisfactory results. It underlies towards the tunnel.

At 334 feet, fault, N. and S. Steep underlie to E.

At 360 feet, vein or joint, S. 37° W. Vertical.

From 386 to 470 feet a 2-3 inch quartz vein, with pyrites, is seen in roof, first on the N.W. side of the tunnel and afterwards crossing to the S.E. side. At 470 feet it abuts against the vein next mentioned.

At 470 feet, vein 5 to 24 inches, with quartz vein on hanging wall side—E. 41° S., underlie 75° to N. 41° E.

BLACK ROCK.

(See Plan No. 1.)

Towards the north end of Lease No. 1404 is the "Black Rock," a cliff of fine-grained siliceous and chloritised sandstone. On a head running W. 34° S. and underlying steeply to N. 34° W. a quarry ("Lindsay's Face") has been opened. A vertical shaft, commencing 209 feet above the level of the Iona Tunnel, has also been sunk to the depth of 143 feet. From a level 80 feet below the top of the shaft a tunnel going E. 20° S. and 120 feet in length connects with the shaft, and along the line of the "head" seen in the quarry above, some stoping has been done. The ore from the quarry, the stope, and presumably from the sinking, still lies at the mouth of this tunnel. It measures 330 tons, and is estimated to contain 4 per cent. of black tin.

The Iona Tunnel (58 feet above the level of the Extended Tunnel) commences on the right bank of Iona Creek, and goes E. 11° N. for 210 feet. It has still 155 feet to go

to its objective, the Black Rock Shaft. From its mouth a tramline has been surveyed, originally designed to connect with the Extended tramline, and to convey ore from the Black Rock Shaft to the mill, but which, after the Iona and Extended Tunnels have been connected, will lend itself to a much larger scheme. The surveyed tramline is 2,850 feet in length.

The Iona Tunnel, so far as yet driven, passes through massive, fine-grained, semi-crystalline sandstone, of mixed siliceous and felspathic material, striking N. 19° W., and underlying steeply to E. 19° N. Just at the mouth, a weathered seam of pyrites crosses the tunnel from north to south. Thirty feet in, a 6 to 12-inch vein of weathered pyrites crosses the tunnel in the same direction, underlying to the east at 40 degrees. One hundred and fifty-five feet in, some north and south veins cross the roof of the tunnel, and are forming stalactites of brown hæmatite.

CENTRAL.

(See Plan No. 1.)

On the summit of a mill 470 feet S. 21° 30' S. of the Black Rock shaft and 830 feet N. 10° W. of the Extended Shaft, the Central Shaft has been sunk to the depth of 63 feet. It will be necessary to sink the shaft 240 feet further to the level of the Extended Tunnel, and the contract for this has been let.

Enormous advantages, in the way of lowering the cost of mining and handling ore, will be derived from the connection of the Iona and Extended Tunnels, not to speak of what may be hoped for in the way of prospecting, and I am glad to say that this most desirable work is now in progress.

Around the Central Shaft, and with its longer axis extending towards the Black Rock on the one hand and towards the Extended on the other, an area roughly estimable at 50,000 square feet, is occupied by the outcrop of a mass of soft ferruginous chlorite containing some tin, and which has been a good deal prospected. Dumps of ore are estimated, by sampling and assay, to contain 500 tons, varying from 1.2 to 1.4 % of tin oxide. This ore, which will leave a handsome profit over the cost of transport and milling, will, of course, be passed down to the tunnel when the extension has been completed, and it will be strange if the tunnel itself does not expose some bodies of payable ore beneath this large outcrop. It may be observed that the presence of the large underground ore bodies in the Extended and Kitchener Mines was indicated by the presence at the surface of chlorite outcrops like that around the Central Shaft.

IVANHOE.

(See Plans Nos. 1, 8, 9, 10, 11, 12, 13, and 14.)

The Ivanhoe shaft is situated on the left bank of the Eureka Creek in Lease No. 1403.

The following are vertical measurements :—

Brace of Shaft (4.4 feet below Eclipse)	..	..	..	..	0
Tramway Level (adit from Tramway)	..	..	..	..	56
No. 1 Level (Eureka Creek Adit)	..	..	..	..	98
No. 2 level	..	..	..	..	180
No. 3 level	..	..	..	..	233
No. 4 level	..	..	..	..	260
No. 5 level	..	..	..	..	280
No. 6 level	..	..	..	..	386

Tramway Adit.—The tramway cutting exposes a large body of ferruginous and chloritised sandstone rock, and into this an adit has been driven, 56 feet below the brace of the shaft, S. 23° E., for 60 feet through sandstones dipping at 60 degrees to E. 28° N. The sandstones are composed of mixed siliceous and felspathic granules, the latter predominating near the mouth of the adit and the former at the inner end. Fifty feet from the mouth good ore was met with and proved to have a breadth of 10 feet on the line of the adit, with a length of nearly 30 feet. This ore was of good quality, and was stoped up to the surface south west of the shaft. Ten feet east of the adit the ore body came to an end on the footwall side of a vein coincident with the bedding planes of the strata. A drive to the east for 34 feet failed to disclose any more ore. At the western end of the excavation the ore comes against a seam or head running N. 19° W., and underlying steeply to W. 19° S. This seam cuts off the ore for the greater part of the distance across, but at the north end a little quartzose ore is seen on the western side. No attempt has yet been made to trace it. This drive should sooner or later be continued for 90 feet to meet the "Ivanhoe No. 2" shaft, from which the ore could be shot down to the tramway level at a trifling cost.

met with on the right hand side. They form the channel of a "watercourse" which, at least in the wet season, is a heavy tax on the duty of the pump. At forty feet a vertical seam (N. 14° E.) gives a further supply of water. At 44 feet a small body of black chlorite with pyrites, quartz, and tin is met with. Its longer axis runs north, and for a distance of about 10 feet it has been stoped up from the 386 to 374 feet level, and is still visible in the roof. It appears to have formed on the intersection of two vertical soft seams, one running N. 33° W., and the other N. 1° E. The latter pours forth a great volume of water. The ore here is probably continuous with that in the "Watercourse Drive" 27 feet below No. 5 level (*vide ante*).

From Mr. Walter E. Cameron's Report "On the Herberton Tin Field,"* we learn that the Ivanhoe crushed, at the Bischoff Mill, 835 tons of ore for an average yield of 7 per cent. of tin oxide. This must have been prior to the acquisition of the mine by the present Company.

From August, 1903, to November, 1906, inclusive, the Ivanhoe Mine has crushed 15,968 tons, mainly from below No. 4 level, for an average yield of 5.2 per cent. of tin oxide (70 %).

Mr. Hope estimates the present ore reserves of the Ivanhoe Mine as follows :—

"In body round No. 5 Level Rise	1,200 tons.
Between No. 5 Stope and No. 5 Intermediate Level ..	650 "
Ore Shoot from No. 5 Intermediate Level Stope and No. 6 Level	650 "
Ore Shoot from No. 5 Intermediate Level, North Branch and No. 6 Level (round winze)	800 "
Near No. 5 Intermediate Level, S.W. crosscut ..	200 "
Total	3,500 tons.

Estimated to contain 4.5 per cent. of tin oxide. At the present stage of development a higher value is indicated, but the lower value is safer."

In mines such as those at Stannary Hills the estimation of ore reserves is always more speculative than in ordinary lodes or reefs, but I believe that Mr. Hope's estimates are fully justified, and are more likely to prove under than over the mark.

IVANHOE, No. 2.

(See Plan No. 1.)

This shaft, 37½ feet above the Ivanhoe Shaft, has been sunk 89 feet, *i.e.*, practically to the level of the Ivanhoe's "Tramway Adit." It bears E. 16° S. from the Ivanhoe Shaft, and the distance is 110 feet. At the depth of 45 feet a level has been driven 40 feet to W. 6° 30' S. on a body of ore which has been stoped up for a few feet and down for 17 feet. From November, 1904 to September, 1905, this mine has crushed 307 tons for an average yield of 5.2 per cent. of "black tin." The work has been abandoned because it was obviously preposterous to wind from a separate shaft when an extension of the Ivanhoe "Tramway Adit" for 90 feet would place the ore, by gravitation, on trucks ready to go to the mill. This connection should be made as early as possible.

From January to September, 1905 (inclusive), the Ivanhoe No. 2 crushed 307 tons of ore for an average yield of 5.2 per cent. of tin oxide (70 per cent.).

MONARCH.

(See Plans Nos. 1 and 15.)

This mine is on the right bank of Eureka Creek, opposite the Ivanhoe, the bearing from shaft to shaft being W. 35° N., and the distance 260 feet.

At 19.7 feet below the Ivanhoe "Tramway Adit" the **Monarch Adit** has been driven to S. 41° W. for a distance of 35 feet. Tin ore of good quality was met with in the adit, and was stoped up to the surface, approximately 40 feet. From the inner end of the adit a shaft has been sunk 73 feet, at which depth a level has been thrown out for 32 feet to E. 29° N. This level is, therefore, 92.7 feet below the Ivanhoe Tramway Adit and 148.7 feet below the brace of the Ivanhoe Shaft, and 31.3 feet above the Ivanhoe No. 2 level.

The following notes on the 73 feet level are from information supplied by Mr. Hope.

* Brisbane: by Authority, 1904.

Eureka Creek Adit (No. 1 Level).—This adit is 98 feet below the brace of the shaft, towards which it approaches on an easterly course. It is used for the drainage of the mine, but, being too little above the level of the creek, has to be defended by a watertight door from the influx of water in flood time.

For about 25 feet to W.S.W. of the shaft ore has been taken out and stoped up nearly to the tramway level. The remaining (western) reach of the level is in hard sandstone beds, with which some shale beds are intermixed near the creek. Reckoning distances from the mouth, it shows :—

At 105 feet a N. and S. seam underlying steeply W.

At 95 feet a soft vein, E. 41° N. Steep underlie to S. 41° E.

At 70 feet a soft vein, E. 41° N. Steep underlie to S. 41° E. Some lode matter on its eastern side has been tried for a few feet on south side of adit.

At 40 feet a soft vein N. 25° E. Steep underlie to E. 25° N.

At 17 feet an 18-inch vein with quartz N. 10° E. Steep underlie to E. 10° S.

No. 2 Level.—This is 180 feet below the brace, and is driven 95 feet to W. 37° S. of the shaft.

The first 20 feet from the shaft is the longer axis of a roughly oval excavation from which ore has been taken to a maximum width of 15 feet. The ore has been stoped up a pipe to No. 1 level. On the (No. 2) level the ore appears to be bounded by a vertical vein running N.E. and S.W. In the middle of the N.W. side of the excavation a vertical seam penetrates the enclosing siliceous sandstones. It runs N. 38° W. and has about 18 inches of pyritous and chloritic lode matter on each side. As this seam has the bearing of the long shoot of ore worked at No. 5 level, I should like to see it followed for some distance. A drive here would explore a large tract of untried ground above the long shoot worked at No. 5 level, and, although the back of the stopes above No. 5 had become poor, there is room enough for better ore to make again.

Beyond the ore body near the shaft the level has been driven across the strike of siliceous and feldspathic sandstones which dip at 60 degrees to E. 37° N., and has revealed nothing worthy of note.

No. 3 Level is 233 feet below the brace. The same ore body which has been worked almost perpendicularly from the surface, is here met with west of the shaft. At this level it is rudely oval in section, with its longer axis of 45 feet extending W.N.W., and its shorter axis of 20 feet S.S.W. It has been stoped up to No. 2 level, and down to No. 4. The ore is bounded for some distance on the N.N.E. side by an irregular vertical head or seam which is traceable through the S.W. end of the shaft. Here, on a course of S. 37° E., it penetrates hard sandstone. In a drive in the latter direction, a few feet from the shaft, it splits into two seams which form a very acute angle. Both veins open out into two-foot seams of ore, which, from 12 to 25 feet from the shaft, are stoped up for about 30 feet. They have a steep underlie to E. 37° N.

No. 4 Level.—This level is 260 feet below the brace. A drive S. 32° E. for 25 feet from the shaft carries the portion of the lode last described in the preceding paragraph. At the shaft it is of the full width of the level, but at the face it is only 15 inches in width. In the opposite direction from the shaft (N. 35° W.) the extensive stopes (connecting upward with No. 3 and downward with No. 5 level) were not accessible at the time of my visit. It is understood that above this level the ore in the back of the stopes narrowed and became poor in quality.

A crosscut driven 25 feet west from the shaft discloses ore in the roof in the last 5 or 6 feet, the value of which above and below has yet to be ascertained.

No. 5 Level.—This level is 280 feet below the brace. It commences with a reach running on the average N. 40° W. for 160 feet. At the N.W. corner of the shaft a seam traverses the country rock from east to west. At first it underlies steeply to the south ; but, at the point where it reaches the south-west side of the level, it has become vertical and has changed its course to that of the level, and pyritic ore is seen beside it. From this point it forms the left wall of the level for 80 feet. About 25 feet from the shaft ore begins to make on its N.E. side, and is stoped up, the stopes connecting upward with No. 4 level, and, in fact, with the surface. The stope shortly increases to a width of 12 feet, which is maintained to a point about 100 feet from the shaft. One hundred and eighty feet from the shaft the ore body narrows to 4 feet, and is bounded by a distinct " hanging wall " on

the N.E. side, the wall being traceable for 34 feet, until it, with the ore beneath it, goes out of the level—or, more correctly speaking, the level takes a slight turn further to the south, and goes out of the ore. Where the ore leaves the level it is seen 12 feet below (292 feet level). At the S.E. end of this 292 feet level the lode matter is black and chloritic, and contains quartz and one per cent. of tin, but as the level goes to the N.W. for 30 feet, it soon became of very good quality, and was 7 feet in width, and was bounded on the N.E. by the well defined hanging wall seen in the No. 5 level itself.

Twelve feet below No. 5 level the lode is seen 50 feet from the shaft between two heads running N. 36° W. and underlying E. 36° N. For 60 feet on this course it has been worked out to a width of about 7 feet, and stoped up to No. 5 level. Sixty-five feet from the shaft (12 feet below No. 5) a seam of ore 2 feet thick goes off to E. 25° N.

Twenty-seven feet below No. 5 level the **Watercourse Drive** goes off to the north. Good ore has been taken out of this drive for the full width of 7 feet and stoped up 12 feet. At the face (30 feet) the ore is confined between two walls or heads underlying as if they would meet at a depth. Under foot the ore narrows between these walls, but it probably lives down to the "Watercourse Drive" in No. 6 level.

One hundred and seventy feet from the shaft on No. 5 level the ore body (and with it the level) turns to W. 26° N., a course which it keeps for 45 feet. Here, rising to S.S.E., it has been stoped up 10 to 15 feet in width to a height of about 40 feet and down to the north to the "West Drive" at the level of 320 feet.

The next reach of No. 5 level goes due north for 30 feet in good ore (4%), which, to a width of 12 feet, has been stoped both up and down. The ore on the level ends with this reach, and is not again met with till the level has been driven 45 feet to N. 40° W., through fine-grained siliceous and siliceo-felspathic sandstones. Where it is recovered, the ore is driven on for 10 feet to the south, and 30 feet to the north, and is stoped up for a width averaging 8 feet. The dislocation which cuts this north and south reach of the ore body in two is not recognisable in the level.

The continuity of the ore from No. 5 level (280 feet) northwards down to the "West Drive" (320 feet level) has already been referred to. This "drive" is not aptly named, as it is a crosscut with a course of S. 30° E. It passes beneath the barren portion of No. 5 level at a point 250 feet N. 40° W. of the shaft. It is driven on an attrition-breccia between two distinct walls which underlie steeply to E. 30° N., and is undoubtedly on what is not only a fault but a "lode" in every respect except that, locally at least, it contains no ore. The lateral displacement produced by it in the ore body at 320 feet amounts to 50 feet. On the E.S.E. side its position is as already noted, and on the W.S.W. side it is 50 feet away, and directly beneath the barren portion of No. 5 level.

In this latter portion of the ore body the ore is 21 feet wide. At 330 feet it fully maintains this width for 22 feet to the north-west, and has been stoped up and down. There is said to be 2% ore below and 4% on the roof. A rise of 15 feet to the south shows masses of good ore between two north and south faults underlying steeply to the east.

The 325 feet level, known as the "**No. 5 Intermediate Level, North-West Branch**," is driven N. 40° W. to a point 75 feet from the "West Drive." It yielded rich ore for a distance of 30 to 40 feet over a width of 6 to 9 feet. In one place, 18 feet from the face, I saw a mass of ore in the roof which must have been worth 20 per cent. at least. Near this place, the "South West Crosscut" nearly due south had been commenced, and at the date of my visit was 18 feet in, in very good ore.

What is known as the "**No. 5 Intermediate Level, North Branch**," goes north from the "North-West Branch" for 50 feet, commencing at a point 18 feet from the "West Drive." For the first 25 feet good ore has been stoped up to a width varying from 12 feet at the south to 4 feet at the north end. At the latter point an east and west fault, with a northerly underlie at 45 degrees, crosses the ore body, which, north of it, is 13 feet wide. At the northern face, 25 feet further, it has tapered to 2 feet, having apparently been narrowed by a vertical head or fault running N. 18° W. along the eastern wall of the excavation. This portion of the ore was said to be rich, and has been stoped up. A winze near the end is going down to No. 6 level, and for some distance is in 12 per cent. ore.

From the large ore body which has been followed down from No. 5 (382 feet) level to the fault in the "West Drive," the "**Intermediate Level, South Stope**," has been broken out at the 315 feet level. The ore lies on a head, or fault, running S. 33° E. and underlying at 55 degrees to E. 33° N. The floor of this stope has been carried 48 feet along the fault, which forms the base of a triangle, the apex on the north-east side being about 15 feet dis-

tant. On the side of the triangle, which runs north and south, the ore has not come to an end, but is too much mixed with country rock to be profitable under present conditions. The stope, worked up to 302 feet, yielded 1 to $1\frac{1}{2}$ per cent. ore.

No. 6 Level.—This level is 386 feet below the brace. Its general direction from the shaft is N. 41° W. Its south-western side is on a seam or fault which can be traced from the shaft nearly to the "crosscut at 153 feet." The seam is, on the whole, vertical, although in places it shows a tendency to underlie to the north-east. Ninety-five feet from the shaft the north-eastern side of the level commences to follow a parallel vertical seam. This seam forms the north-eastern wall of the level to a point 265 feet from the shaft, whence it forms the south-western wall. From 145 to 190 feet (measured from the shaft) the seam becomes a soft vein containing lenses of quartz up to a foot in thickness.

Between the two seams the roof of the level shows in places an attrition-breccia, generally of shaly debris, which can be best seen in the following places (measurements from shaft):—15 to 40 feet, 105 to 145 feet, and 298 to 310 feet (the face). The level is undoubtedly driven in a fault, which represents the long stanniferous shoot at No. 5 level, 106 feet above, and yet, with trifling exceptions, it is barren of tin.

The first occurrence of tin is at 113 feet from the shaft. Thence to 127 feet low grade ore has been stoped up for a few feet. The second (and last) is 15 feet short of the face, where a slightly pyritous vein of chlorite on the south-western wall has been risen on for 10 feet.

In spite of the poverty of this level, the strong and regular persistence of the fault-lode justifies the belief that at a lower depth payable ore will make again. It will be remembered that in the Kitchener Mine, ore too poor to work at the depth of 145 feet had improved in quality to well above the point of being payable at the 213 feet level. It may also be said that it is the **rule** in this district that faults which in some places are mere seams or clean cuts are elsewhere filled with lode matter.

Two hundred and sixty-six feet from the shaft, the "**West Crosscut**" leaves No. 6 level and goes W. 13° N. for 80 feet. After traversing sandstones for 60 feet it meets with an ore body 10 feet in width, and extending for 40 feet south and 12 feet north. Where first met with, the ore was of 10 % grade, and was stoped up to the south for 20 feet. To the south it was of 1 to $1\frac{1}{2}$ per cent. grade, and was stoped up to the south for 15 feet, ending against a seam or fault running W. 22° N., and underlying at a steep angle to N. 22° E. A drive has been carried 22 feet through sandstones to S. 34° W. Immediately behind the seam or fault the sandstone shows streaks of galena. At the face of the drive a vertical seam runs S. 35° W., and the adjacent rock contains pyrites and a little galena.

From the "West Crosscut" the 385 feet level is driven N. 3° W. for 70 feet, its western wall following a vertical seam. The level, as already mentioned, carries ore for 12 feet in this direction. A blank of about 42 feet succeeds, after which pyritous chlorite ore occupies the level to the face. The ore here is not bounded on the west by the seam, but occurs on both sides of it. It is now being opened out and is averaging 4.5 per cent.

The ore body in this level, reached by the "West Crosscut," is directly beneath, and almost certainly continuous with the body worked in the "No. 5 Intermediate Level, North Branch" (325 feet level), but neither the fault in the "West Drive" of No. 5 level nor the body of ore which has been worked up to the south from the fault at 320 feet to No. 5 level at 280 feet has yet been detected in No. 6.

The ore at the present face of No. 6 level is the furthest north to which ore has yet been traced from the shaft. I strongly incline to the belief that while the fault-lode persists down to 386 feet the **shoot of ore** only comes into this level 40 feet south of this crosscut, and having been traced for 110 feet to the north, as against something like 285 feet on No. 5 level, has still 175 feet to go. At least, I should drive for that further distance without expecting the shoot to have finally dipped beneath the 386 feet level.

At 153 feet from the shaft, a crosscut leaves the main No. 6 level on a bearing of W. 25° S. for 20 feet. It cuts two vertical heads running W. 17° N. Turning to W. 29° N., it follows the strike of the rocks for 35 feet, cutting, at 18 feet, a seam running N. 7° E. and underlying steeply to E. 7° S. The strata dip to N. 29° E., and consist of siliceous grits containing flattened pebbles (shingles) of black shale. The face of the crosscut shows alternations of sandstone and shale, with pyrites along the bedding-planes, and assays 0.5 % of tin oxide.

Seventy feet from the shaft, the "**Watercourse Drive**" goes sinuously to the north-east through sandstones and shales for 44 feet. At 30 feet, several north and south seams are

A seam containing ore runs W. 40° N. and underlies steeply to N. 40° E. The bedding planes of sandstone and shale run in the same direction, and dip at 60 degrees to N. 40° E. In the level a mass of ore runs E. 29° N. for 28 feet from the centre of the shaft between two heads which underlie steeply to S. 29° E. The ore attains a maximum thickness of 5 feet in the level. Twenty-eight feet from the shaft it abuts, and apparently ends, on a seam of quartz running N. 29° W. and underlying steeply to E. 29° N. Near the face the sandstone country is intersected by two parallel heads running W. 44° N. and underlying steeply to N. 44° E.

There are 35 tons of ore at grass, estimated by sampling and assaying to be worth 14 per cent. of black tin.

The fault-lode in the "West Drive" of No. 5 Ivanhoe Level is of importance to that mine, not only because it displaces an ore body for fifty feet horizontally, but because it may itself prove to contain ore. It may also be suspected that it has something to say to the Monarch, as the latter is practically on the line of it. It is singular that the fault-lode has not been detected in No. 6 Ivanhoe Level. Without any immediate expectation of finding ore, I should like to see the fault-lode followed by a winze from 320 down to 386 feet (No. 6 level), and the level then driven on the fault-lode—say, 80 feet, to the Monarch Shaft, which would have to be sunk a further 237.3 feet to connect with the level. This would improve the ventilation of the Ivanhoe, and facilitate hauling from the Monarch, and, moreover, as I believe the Monarch, at the 73 feet level, to have been working an ore body in the "**West Drive**" fault-lode, I should expect further ore bodies to be found in driving on the fault at No. 6 level.

ECLIPSE.

(See Plans Nos. 1, 16, and 17.)

The shaft, 4.4 feet above the Ivanhoe Shaft, is situated on the left bank of Eureka Creek in Lease No. 1403. It bears E. 10° S. from the Ivanhoe, the distance being 750 feet.

In the tramway cutting, between the shaft and the creek, is a large body of sandstone, in which, while the siliceous material is unchanged, the felspathic constituent has been "chloritised"—an alteration which the experience of the district has proved to be favorable to the presence of tin.

As seen in **No. 1 Level** (106 feet) the principal ore body appears to be on, or in, a nearly vertical seam, which has a general bearing of E. 34° N. This seam is followed in the level for 77 feet W. 34° S., but except that, about fifteen feet from the shaft, it has locally opened out into a one-foot vein of chlorite with pyrites—apparently poor in tin—nothing of note has occurred. In the opposite direction (E. 34° N.) about 15 feet from the shaft, ore begins to make. Thirty-five feet from the shaft it was of 10 per cent. grade, and for a width of fifteen feet was stoped up for 30 feet, rising towards the shaft. Below a point 55 feet from the shaft the stope has been carried down to 135 feet (15 feet above No. 2 level), and is connected with No. 2 level by a winze. Sixty-five feet from the shaft the top of the stope comes down to No. 1 level. After dipping a few feet below the level, the top of the stope again rises to the level 90 feet from the shaft. Ore has been worked up from the bottom of the stope (as already defined) to No. 1 level from a point 90 to a point 110 feet from the shaft. From 110 to 133 feet (the face) a fragment of the original No. 1 level remains, but the only representative of the ore body is a soft seam traversing hard crystalline sandstones.

The sandstones and shales (more shale beds than usual) across which this ore body makes its way, strike N. 38° W. and dip to E. 38° N. at a high angle. Sixty-three feet from the shaft and 26 feet below No. 1 level, 4 feet of sandstone beds are more or less impregnated with ore, the uppermost eight inches being full of white pyrites. Drive (or Crosscut) D. has followed the pyritic bed for about 8 feet along the strike to the S.E., but the pyritic mass dwindled in a few feet to a mere seam, and the beds below it were destitute of ore.

A drive on the same level as No. 1 goes due north from the shaft for 65 feet to within a few feet of the shallow "Ladysmith" shaft. The drive traverses sandstones and shales which have the same strike as the beds enclosing the ore body, and dip at 60 degrees to E. 38° N. Fifteen feet from the main level a head or seam runs N. 35° W., and underlies at 45 degrees to E. 35° N.

No. 2 or 150 feet Level is directly beneath No. 1, and extends for 155 feet E. 34° N. There is no drive in the opposite direction, as this portion of No. 1 was barren.

No. 2 Open Cut is 130 feet west of No. 1. It consists of two shelves, the lower about 12 feet deep and about 40 feet in length by 20 in width, and the upper, 6 or 7 feet in depth, with a length and width of 25 feet. The rock is kaolinised sandstones and shales. A head runs north and south through the western side of the lower cutting, and underlies to the east. Tin ore of over 1 per cent. grade has been taken from it. One assay on this level gave 2 per cent. A number of small leaders also furnished ore. The dump below the cutting assayed 1.3 per cent. East of the lower end of the cutting a patch of ore gave 2.1 per cent. A winze was sunk from the bottom of the lower cutting to the depth of 80 feet, and a drive 60 feet in length was thrown out at E.S.E. It cut, I was informed, some tin ore near the face, but, as it was full of water, I could not visit it.

On the hilltop, 400 feet east of No. 1 Open Cut, a prospecting shaft (the "**Monk**") is being opened in hard siliceous and felspathic sandstone, with garnets, near a spot where, some eighteen years ago, 17 tons of 15 per cent. ore were taken by the then owner (Wile-smith). At the depth of 20 feet, a short drive has been commenced to the S.W. It cuts a body of rich tin ore, worth 30 or 40 per cent. in places. It appears on the whole to underlie to N.N.W., but is as yet ill-defined both as regards direction and quantity. Besides tin oxide, the ore is composed of chlorite and quartz with minute garnets.

About 30 feet S.S.W. of the "**Monk**" another shaft has been commenced, and is down about 12 feet. It is on an undefined vein of chlorite, black ironstone, and manganese, with prospects of tin. The vein apparently runs N.W. and S.E.

Ninety feet to the south-east, another piece of prospecting has been commenced, and a hole has been sunk about ten feet in a chlorite rock full of minute garnets and showing prospects of tin.

On the left bank of a gully running east and draining the Arbouin Hill on the north is the "**Last Call**" Shaft, to which, from the north end of the Arbouin main tunnel, a leve bench for a tramline, 300 feet in length, has been cut. In an outcrop of quartzite, with garnets, a shaft has been sunk to a depth of ninety feet. The shaft contained water, but I was informed that to a depth of 70 feet 6 per cent. ore was obtained, and that beneath that level the lode was two feet wide and the ore $1\frac{1}{2}$ %.

Sixty feet south-east of the Last Call, and nearer the gully, "**Brett's Mine**" has been opened. It consists of a short drive towards the Last Call, and a little stoping, from which, presumably, ore has been taken, although all that can now be seen is a clay seam beneath a distinct hanging wall, dipping at 60 degrees to the south-west.

One hundred and eighty feet south-east, and on the opposite or right bank of the gully, is the "**Admiral**," to which a tramline has been laid to the mouth of the Arbouin Main Tunnel, the intention being to haul ore up to and through the tunnel to the horse tramway. The first working is a shallow open cutting to the south, through siliceo-felspathic sandstones, and terminating in a short W.N.W. level from which a shaft has been sunk to a depth of 70 feet. As seen in the level, the lode matter is from 2 to 6 feet in width and has a steep underlie to S.S.W., in which direction it shades off into barren country rock. The shaft contained water, but I was informed it was in good ore to a depth of 60 feet. Dumps beneath this cutting assayed 2.2 per cent. of tin oxide.

Thirty feet S.E. of the shaft is an open cutting in quartzite with small garnets. The cutting shows a brecciated lode-formation, four feet in thickness, underlying at 40 degrees to S.W. Some lumps of good tin ore, mixed with chlorite and minute garnets, can be picked out.

Eighty feet S.E. of the seventy feet shaft a shaft was sunk to a depth of 110 feet. It is said to have gone out of the lode at 60 feet. At sixty feet a level, forty feet long, was driven, and $2\frac{1}{2}$ feet of lode was stoped up to near the surface. These stopes are said to have yielded 10 per cent. when crushed at the Bischoff Mill, Watsonville, and the present Company crushed the seconds for a yield of 3 per cent.

From the Last Call to the extreme south-eastern end of the old Admiral workings, a distance of about 400 feet, there appears to be a continuous lode, or, at least, a stanniferous zone, well worthy of further development, while the "**Monk**" and adjacent workings may lead to something of importance. This would be mining like any other mining, and would, of course, require deep shafts and long drives in hard rock, whereas the charm of the Arbouin lies in the fact that it demands next to nothing in the way of outfit beyond chutes, a tramline, and a blacksmith's shop. It would be advisable to employ a diamond drill to locate the ore bodies before committing the Company to the full expense of sinking and driving.

The seam on which the ore body in No. 1 level was, so to speak, "strung," persists in No. 2 level throughout its entire length (except that it leaves the level 90 feet from the shaft, to come into it again at 115 feet), but the ore is for the most part missing. The seam traverses sandstones with bands of shales, striking in the same direction as in No. 1 level, and dipping in the same direction at 55 degrees.

Near the shaft the seam becomes a vein of some width, attaining a thickness of 2 feet at a point 17 feet from the centre of the shaft, although at 32 feet the vein has again dwindled to a mere seam. Opposite the shaft the vein encloses an attrition-breccia of sandstone and shale. Where the vein is at its widest it contains quartz calcite, fluorite, and pyrites. I believe that this "bulge" of the vein to 2 feet represents the bulge of the vein to 1 foot, 15 feet to W. 34° S. of the shaft at No. 1 level, and the fact that in a vertical distance of 144 feet, the lode has "shot" 32 feet to E. 34° N. raises a strong presumption that the "shoot" has followed the dip of the strata. The fact that from No. 1 to No. 2 level the vein has doubled in thickness, and has become more highly mineralised, makes it very probable that it will continue to increase in size downward, and may open out into a body of payable ore. A winze, 55 feet from the shaft, has been sunk a few feet below No. 2 level, and, if continued, should meet with the shoot which I believe to be increasing in size, and may contain tin ore.

One hundred and twenty feet from the shaft, the rock on both sides of the seam begins to be chloritic and is charged with pyrites, and it maintains this character to the face (155 feet). It assays, I am informed, 0.4 to 0.7 per cent. of black tin, and is on the whole improving in quality as the drive goes on. One hundred and thirty feet from the shaft, a drive has just been commenced on a head running north and dipping steeply to the east. A chlorite vein containing pyrites and calcite, on the east side of this vein, gave an assay of 12.6 per cent. of "black tin." The head gives off a considerable stream of water.

The absence of ore in No. 2 level just below where No. 1 level was at its best has naturally given rise to a good deal of concern, but it appears to me that the fact is capable of a feasible explanation.

The "shoot" near the shaft, dipping down the plan of the fault to E. 34° N., has already been attended to, and it affords an illustration of a natural law affecting the deposition of ore.

Among stratified rocks certain beds are more favorable to the deposition of ore than others. In other words, they either contain some mineral which furnishes a precipitant for this or that ore, or they contain soluble mineral matter ready to be replaced by ores. Two conditions are essential to the formation of an ore-impregnation of the class prevailing at Stannary Hills. The first is a channel for metals in solution, and the second is contact with rocks of a composition favorable to the deposition of compounds of the metals. In the case now before us, the long fault or seam supplies the necessary channel, and it may be assumed that the strata met with in No. 1 level were favorable to the deposition of the ore—since the ore impregnated them. The channel (fault) continues down to No. 2 level, and the observed dip of the strata should bring the **beds favorable to the deposition of ore** down to that level further from the shaft than in No. 1. These beds were, in fact, overdue at the point where ore began to make towards the face of No. 2 level, but a slight displacement may have easily been brought about by a "flat" fault between the two levels, and which the workings afford no opportunity of observing. I regard it as almost a certainty that the ore now making in the No. 2 level is the beginning of the shoot met with above, in, and below No. 1.

From February, 1904, to September, 1906 (inclusive), the Eclipse has crushed 1,977 tons for an average return of 5.3 per cent. of tin oxide (70 per cent.).

It would clearly be extravagant to continue to work the Ivanhoe and Eclipse as separate mines, with double the necessary expense for hauling and pumping. The mines should be connected as soon as possible—preferably by the further sinking of the Eclipse Shaft and the extension of the Ivanhoe No. 6 level.

The **Ladysmith** shaft is 72 feet north of the Eclipse shaft, and 25 feet below it, and 30.5 feet above the tramline. Timbering and an accumulation of water made it impossible to see what had been worked or aimed at, but the fact that it has a steep underlie to the east makes it probable that something underlying in that direction has been followed down.

HORNET'S NEST.

This mine is on the left bank of Eureka Creek, about 600 yards above the Eclipse. It is not at present being worked. The following description is from Mr. Maclaren's Report :—

"The workings . . . comprise three main ore bodies. The most southerly is the General White, upon which a shaft has been sunk 80 feet deep. The 'formation' is 3 feet to 4 feet in width. On the middle lode a shaft fifty feet in depth has been sunk, revealing an ore body ten feet wide. From an open cut 12 feet by 10 feet by 6 feet a fire assay returned 7 per cent."*

ARBOUIN.

The Arbouin Mine is about 4 miles east of the Stannary Hills township. It is connected by about a mile of horse tramline and a short wire ropeway with the main tramline from Stannary Hills to the mill at Rocky Bluffs, on the Walsh River.

Travelling by the road, the sandstones and shales of the Stannary Hills mining centre give place in about a mile to granite and porphyry. These are again replaced, about half a mile from the Arbouin, by sandstones and shales. These stratified rocks are, however, more felspathic on the whole than at Stannary Hills, and have undergone more pronounced metamorphism. The less siliceous members of the series are almost entirely chloritised, and where they are weathered are either kaolinised or red with iron oxide. In addition—especially to the east, towards the "Last Call" and "Admiral"—they are full of minute garnets.

The "Greek Lode" is the "mother" of the large tin deposits on the surface of the Arbouin Hill. Its general course is W. 29° N., and its underlie at 60 degrees to N. 29° E. From the main tunnel, 290 feet from its mouth, near the tramline, the lode has been driven on for 140 feet to W. 29° N., and 60 feet to E. 29° S. In the western drive it is for the most part a mere vein or clay seam, carrying a little tin. Forty feet from the main tunnel ore of good quality was met with, and a rise was put up to the surface in the "Greek Open Cut." Here the ore was worked from the surface for 60 feet to W. 29° N., and for 40 feet to E. 29° S. when it ran across the north corner of the large "No. 1 Open Cut." In this latter it was worth 3½ per cent. In the Eastern Drive, 20 feet from the tunnel, 18 inches of ore was met with, and was followed down in a winze for 18 feet, being worth about 1½ per cent. of tin oxide, and up for 13 feet, worth 6 per cent., when it pinched to a seam, as it did also in the drive. The remaining 40 feet of the drive contained no ore. The Greek Lode is also met with in "No. 1 Adit," which runs 120 feet into the hill from the northern stope, 8 feet above the Main Tunnel. Here, as seen in a drive 40 feet to W. 19° N., it underlies at 60 degrees, and has from 1 to 2 feet of attrition-breccia and a clean-cut hanging wall, but no well-defined footwall, and apparently not much tin. This drive is within 60 feet of the rise in the eastern drive from the Main Tunnel, and is in quartzites, with some beds of felspathic sandstone. The lode is also worked at the surface on a general bearing of W. 19° N. for 30 feet in that direction from the line of No. 1 Adit, and for 120 feet in the opposite direction. Eighty feet from the line of No. 1 Adit the lode is stoped down from the surface into the Magazine Tunnel, a depth of 45 feet. In Miller's Open Cut, 60 feet east of the Magazine Tunnel, a seam of iron ore running N.W. and underlying at 45 degrees to N.E., is either the "Greek Lode" or a branch of it. It gave assays of 0.9 and 1.2 per cent., but values have not yet been traced to the east.

This "Greek Lode," occasionally containing bunches or lenses of good tin ore, but for a large part of its course practically barren, has impregnated with tin ore the large mass of chloritic, ferruginous, and kaolinised rock worked in "No. 1 Open Cut" to the south. This cutting is now down to the tunnel level in the central part, the surface at the northern end being 84 feet, and at the southern 53 feet, above the tunnel. A winze also goes down on it from the tunnel for thirty feet. No. 1 Open Cut has yielded a large proportion, certainly more than three-fourths, of the total product of the Arbouin. Its material is loose and earthy, and can be sent in any required quantity straight from the end of pick or crowbar into trucks standing on the rails in the Main Tunnel, so that mining costs are reduced to a minimum, and a grade of ore very little higher than what will pay for milling yields a profit. The general run of the ore is low, but bunches of exceptionally good quality bring up the average, and the open cut can always be relied on to keep the mill employed.

* Report on Stannary Hills Tin Mines, &c. By J. Malcolm Maclaren, Assistant Government Geologist. Brisbane: By Authority, 1900.

No. 3 Cut.—A trench ten feet above the level of No. 2. The bottom shows a kaolinic mass with veins and films of red and brown hæmatite, apparently poor in tin.

No. 4 Cut.—Three chains east of No. 3. An opening on gossany iron ore, showing a little tin in the more siliceous portions. An assay gave 1 per cent. of tin oxide.

No. 5 Cut.—One hundred feet east of No. 3, in gap through crest of ridge. Chlorite and kaolinised greywacke, with films and veins of iron oxide. Assays gave 0.3 to 0.9 per cent. of tin oxide.

No. 6 Cut.—On northern fall of hill, about four chains north-east of No. 5 : trench in quartz and red and yellow gossan. Sample B. assayed 1.1 per cent. of tin oxide.

No. 7 Cut.—One chain N.E. of No. 6. Trench, 12 feet long by 7 feet deep. Kaolinised greywackes, with a 15-inch seam of gossan, consisting of kaolin, chlorite, quartz, and iron oxide. Sample C. gave 0.2 per cent of tin oxide.

Gossan ores are traceable at intervals by fallen rocks from No. 5 to No. 7.

Without being enthusiastic about it, I should advise holding and working the ground for the period to which the option extends. Prospects of tin may be obtained along a stretch of about 12 chains, and the similarity of the country to some portions of Stannary Hills is sufficient reason for hoping that something will come of the prospecting operations.

GENERAL.

The foregoing notes and the plans show that the Stannary Hills Mines are located in a series of sandstones and micaceous shales striking north-north-west, and for the most part dipping at high angles to east-north-east. That this dip is not continuous, and that consequently the strata do not form one continuous series, with a total thickness calculable from the angle of the dip and the length of a line drawn across the strike, becomes evident from the contortions observable only where the shaley members of the series are largely developed; for instance, on the tramline between the mouth of the Extended Tunnel and the north-western corner of Lease No. 1403. The strata are repeated again and again, so that it is impossible to estimate their total thickness.

This belt of stratified rocks extends on the one side to within a few miles north of Boonmoo, and on the other to Irvinebank and Newellton, but is interrupted in places by the occurrence of granite and porphyry. On Eureka Creek it has a width of about two miles, and lies between two masses of porphyry rocks.

The "sandstones" are not the usual aggregations of rounded grains of silica, but, as originally deposited, must have been composed of granules of silica and silicate of alumina in varying proportions. The silica was probably derived from the degradation of granite, and the silicate of alumina from basic igneous rocks. The mixture has resulted in sandstones of the type to which the name "greywacke" was formerly, and might still be, usefully applied.

After their deposition, and, I think, only partial consolidation, these strata were crumpled into acute folds by pressure from E.N.E. or W.S.W., and the pressure gave rise to heat, which brought about an alteration in their aluminous constituents. Crystals of felspar were freely developed in the matrix. The more aluminous and magnesian rocks have often undergone "chloritization," and the development of crystals of mica, and as this occurs as a rule where the strata are intersected by fissures of faults, it may reasonably be assumed that it is due in some measure to aqueous action.

A study of the plans will show that the stratified rocks are crossed by innumerable fissures. These fissures vary from clean cuts, usually designated "heads" or "seams," to "veins" of clay or "lodes" of subsequently-introduced mineral matter and faults which may either be clean cuts along which movement has taken place or may be filled with a breccia of angular fragments of the adjacent rock crushed and ground by the movement of the rock masses on either side.

It is a singular fact that in the vast majority of the fissures of the district the striæ or "slickensides" are almost horizontal, from which it may be inferred that the movement was in most cases horizontal. Several instances of considerable lateral displacement of ore bodies have been noted, but hardly any of material vertical displacement.

Although fissures run in every direction they are most numerous in the line of strike of the strata.

Incidentally, it may be said that diamond drilling would probably effect a great saving in the Ivanhoe, Eclipse, Kitchener, Extended, Central, and Black Rock.

The present Company has crushed from the Arbouin, mainly from No. 1 Open Cut, from July, 1904, to November, 1906 (inclusive), 23,893 tons for a yield of 1.2 % of tin oxide (70 %).

CALEDONIAN.

(See Plan No. 18.)

The Caledonian is one of the oldest Watsonville Mines, having been worked almost continuously (in spite of the low prices to which tin fell for some years) since 1880. I first officially reported on it in 1882,* although I had previously seen it in 1880. To Mr. Sydney B. T. Skertchly we are indebted for the only description of the workings up to 1895, which I have been able to obtain.† Plan No. 18, herewith, is a combination of Mr. Skertchly's plan of old workings no longer accessible, with measurements and observations made by Mr. Hope and myself during the last month.

The mine has only been recently acquired by the Stannary Hills Company, who commenced cleaning and opening it up in November last. The workings accessible to me in three recent visits were chiefly those which have been carried on by tributors since the date of Mr. Skertchly's report.

It will be as well to preface my own recent observations by a quotation from Mr. Skertchly's report (page 18).

"The Main Shaft is straight, and about 160 feet deep. The rock at the bottom is granite.

"**Drive A** is about 70 feet long, but only about 40 feet are now open. Its direction is 320 degrees. At ten feet from the shaft a dyke of diorite, platy in structure, is intersected, which pitches at an angle of 53 degrees towards the shaft. This and similar dykes are locally known as cross-courses. At 21 feet the 'lode formation' comes on, and it is clearly only a stanniferous portion of the diorite with much quartz. The stanniferous part or lode seems to run at an angle through the dyke, for, whereas the trend of the diorite is approximately north and south, that of the lode is north-east and south-west.

"**Drive B.** starts at 30 feet along Drive A., runs at 251 degrees, and is 26 feet long. It follows the lode.

"**Drive C.** starts at 4 feet from the end of Drive B., and is carried 38 feet at 290 degrees, all in lode stuff. Here another dyke or cross-course, of similar flaggy diorite to that before mentioned, is encountered, and the drive takes a sharp bend to the north-west for 11 feet, and terminates at a winze 45 feet deep at an angle of about 75 degrees.

"**Drive D.**—From the bottom of the winze a drive goes southerly, and the rock is granite, and contains a little copper ore. The details are as follows :—

Feet.	Total feet.	Bearing.	
17	17	146°	Granite.
12	29	105°	'Crosscourse' of flaggy diorite 3 feet wide, hading easterly at about 85 degrees.
58	87	105°	All in lode stuff. A little tin at 54 feet, and then a thin seam, carrying copper running along the drive. Tin pretty plentiful. Stopped overhead.
8	95	153°	Rise 6 feet with the so-called 80-foot level.
14	119	259°	The drive is also continued in the opposite direction (79 degrees) from the starting point of the 259-degrees section of the level.

"**Drive E.**—At 3 feet north-west from the bottom of the main shaft is a winze 27 feet deep sunk on the lode at slope of 70 degrees. From it Drive E. goes westerly, as follows :—28 feet, bearing 251 degrees to winze. A little tin all along the drive, and at the west end a thin seam of steatite with rich tin ore was found, which continued down the winze in a westerly direction. The winze is 11 feet deep vertically. Immediately west is another winze, at the top of which, on the south side, the crosscourse is seen. Very rich tin was got on both sides of the crosscourse.

"Another 11-foot winze is sunk close by, vertical, and carrying very rich tin all the way. At the bottom the cross-course is again intersected, having the same thickness, direction, and hade as before, but the rock is more compact."

* "On the Tin Mines of Herberton, Western, and Thompson's Creek Districts," &c., by Robert L. Jack, Government Geologist, Brisbane, by Authority, 1883.

† Report "On the Tin Mines of Watsonville," &c., by Sydney B. I. Skertchly, Assistant Government Geologist. Brisbane, by Authority, 1897.

My own observations (November-December, 1906) follow.

A tunnel goes into the hillside S. 35° W. for 140 feet to the Main Shaft. The latter comes down vertically from the hilltop, meets the tunnel at 80 feet, and is sunk 80 feet below it.

From the Tunnel Level at the shaft a shoot or pipe of ore has been stoped up to the surface, rising to the north.

About 20 feet from the main shaft, towards the mouth of the tunnel, an underlie goes down about 90 feet to W.N.W. at 27 degrees. It has been on ore as far as the last 20 feet; thence it has followed a very distinct "head" underlying steeply to S.S.W. From the end of the underlie, a winze (marked by a painted letter "J") follows down this "head" on diorite for 40 feet. Water is standing in the winze at 30 feet. The object of this winze was to get into the old workings described by Mr. Skertchly.

From the tunnel, close to the Main Shaft, a winze (with ladder-way) goes down vertically for 11½ feet. (Here a drive goes out from it for 10 feet to the north-east.) The winze then continues, on an underlie of 50 degrees, for 16 feet to the N.W. There a level is thrown out to the S.W. for 29 feet in a dark rock (diorite?) siliceous and pyritous, with stopes above. From the end of this level a winze goes down for 11 feet. Here the last owners left some rich ore, which, however, was soon taken out by the tributors. The underlie shaft goes down to the 160 feet level, but its lower part is for the present inaccessible. It probably joins the old workings at the South-Western end of Drive B. of Mr. Skertchly's Plan.

In the tunnel, from the main shaft north-eastward to the 90 feet underlie winze, the rock has a dark felspathic base, as if it had originally been a basic-igneous rock, but it is highly quartzose, the quartz having, I believe, replaced some of the original constituents and been deposited as in a reef. As traced down the underlie, the quartz becomes less marked, and its place is taken by pyrites. The remainder of the tunnel is in granite.

Seventy feet north-east of the Main Shaft a winze (which may be distinguished as "Wilesmith's") goes vertically in diorite from the level of the tunnel. At the depth of 45 feet there are short drives to E.N.E. and W.S.W., through dark siliceous diorite. The face of the former drive shows a seam, dipping steeply to N.N.W., and carrying some tin. An assay gave only 0.1 per cent. of tin oxide. In the end of the latter a triangular mass of ore assayed 0.7 % of tin oxide. A crosscut to S.S.E., through diorite, touches the granite 16 feet from the winze. Another crosscut to N.N.W. from the winze leads (through diorite) to "Trevennan's Drive," 45 feet below the level of the tunnel. The whole of the drive, 224 feet to E.N.E. and 65 feet to S.W., is in diorite, which is probably in the form of a dyke underlying to the north beneath the tunnel.

A few feet E.N.E. of the crosscut from Wilesmith's winze, a vein of ore runs along Trevennan's Drive to E.N.E. For about 20 feet along the drive, it has been stoped up to Wilesmith's winze. It is said to have given 12 tons of 16 per cent. ore.

Forty-five feet short of the E.N.E. face of the drive, a soft pyritous vein is seen in the roof underlying to N.N.W. It was stoped down for about 13 feet to a depth of 6 feet, when it pinched out. A two-foot pipe of ore was also stoped up to about 12 feet from the floor of the drive. A sample from this vein taken from the southern side of the drive assayed 0.2 % of tin oxide.

South-west of the crosscut from Wilesmith's winze, 10 % ore is said to have been taken out of Trevennan's drive, in some places to a width of 20 feet. The stuff which is left is, according to assay, considerably under 1 %. The south-west end of this drive is holed through (down) into old workings—probably about the point where Drive B. of Skertchly's plan leaves Drive A., via the "winze with ladder way," starting from "close to the main shaft" previously referred to.

Midway between the crosscut from Wilesmith's winze and the S.W. face of Trevennan's Drive a branch drive is carried 43 feet to the west. For the first half of this branch stopes have been carried a few feet above the roof. Samples from the floor of the drive, beneath the stopes, showed very poor ore.

Below the crosscut to Trevennan's Drive the winze was filled up with rubbish for a few feet when the Company commenced operations in November. When the mullock had been cleared out, and a few feet had been sunk in diorite, ore of good quality made its appearance 50 feet below the level of the tunnel, and at the date of my last visit still formed

the north-western wall of the winze at the then depth of 52 feet. Highly quartzose portions of it were probably worth 40 % of tin oxide, while the remainder with a matrix of dark pyritous diorite (?) was probably good for 10 per cent. On picking in near the east end of the shaft the ore was found to be at least 18 inches thick. This was on my last visit to the mine (December 8th). The latest news is that the ore is no longer touched in the winze, so that it must either have dipped to the north-west or pinched out—more likely the former. It is not proposed to open out on this ore body until the winze has been sunk to the level of old workings, with which it can be connected by 70 feet of driving to W.S.W.

It would be useless to lay down any scheme of development until the old workings are again opened to inspection. According to Mr. Skertchly's notes, really good ore was taken from these workings "in lode formation," which he regarded as merely stanniferous portions of the diorite, with much quartz. This is quite in accord with my own recent observations, and with the view which I took when the mine was new 26 years ago. At all events, the tin does not occur in the granite, but in a dark rock with a dark felspathic ground-mass, originally, I conjecture, a basic dyke, but now altered beyond recognition, chloritised, and to a great extent replaced by quartz. Fully convinced that **no** petrological name exactly fits it, especially as it varies ad infinitum, according to the secondary minerals introduced, I call it diorite, merely for the sake of distinguishing it from the barren ground.

It is not conceivable that the early holders of the mine took all the ore out of it, as, owing to the low price of tin, only rich ore would pay them. The ore body met with in sinking the winze is entirely new, although it may yet be connected with the old workings. I am of opinion that the Caledonian is still a valuable mine, and that as long as the diorite is kept in touch with, ore bodies will be met with wherever veins or seams intersect it.

Should it be necessary to open up the mine on a large scale, after connecting Wile-smith's winze with the old workings, I see no reason why the old "main shaft" should be the channel of haulage. It would be better to make Wilesmith's winze a main shaft, as the small amount of cover above it could easily be removed, and the winze could be connected with a shaft of suitable dimensions, and ore could be delivered at the tunnel level.

The trouble with the Caledonian is that it must either crush at a mill of its own, send its ore to the Bischoff Mill, or transport the ore to the Stannary Hills Company's Mill at Rocky Bluffs, on the Walsh River. The first and last of these courses would only be warranted by very large **proved** ore reserves, especially as the surveyed tramline from the Bluffs to Watsonville has yet to be built. The middle course is the only one possible, from a business point of view, during the period occupied in development.

BRITANNIA.

This mine has been under option to the Company for the last four weeks. It lies about 2½ miles north-east of Boonmoo Junction, and at an altitude of some 300 feet higher. A road or tramline could easily be made from the junction, or from the 32 mile post on the Chillagoe railway to the foot of the hill, about 200 feet below the mine. It occurs in a belt of sedimentary rocks, which succeed the porphyry and granite extending for the greater part of the way from Boonmoo. These sedimentary rocks are very likely the continuation of the Stannary Hills mass.

First, on the southern side of a reach from west to east and then across a gap, and along the crest of a lower ridge to north-east extends the outcrop of a mass of hard rocks, very siliceous, but occasionally containing aluminous material in which crystals of felspar are developed by alteration.

All that has been done is the work of three men for four weeks, and naturally does not amount to much.

No. 1 Cut is the westmost working. It shows a weathered yellowish rock with crystals of felspar which at first sight looks like an elvan, but is seen merging into less decomposed siliceous and felspathic greywacke. In this, from west to east, is a 3 feet vein of rubbly ferruginous gossan, with red and yellow ochre, green and black chlorite, and quartz. Small crystals and masses of tin can be detected in the quartz and gossan. Sample A. assayed 2.9 per cent. of tin oxide. A heap of gossany ore, 13 x 4 x 2½ feet, is lying below the cut.

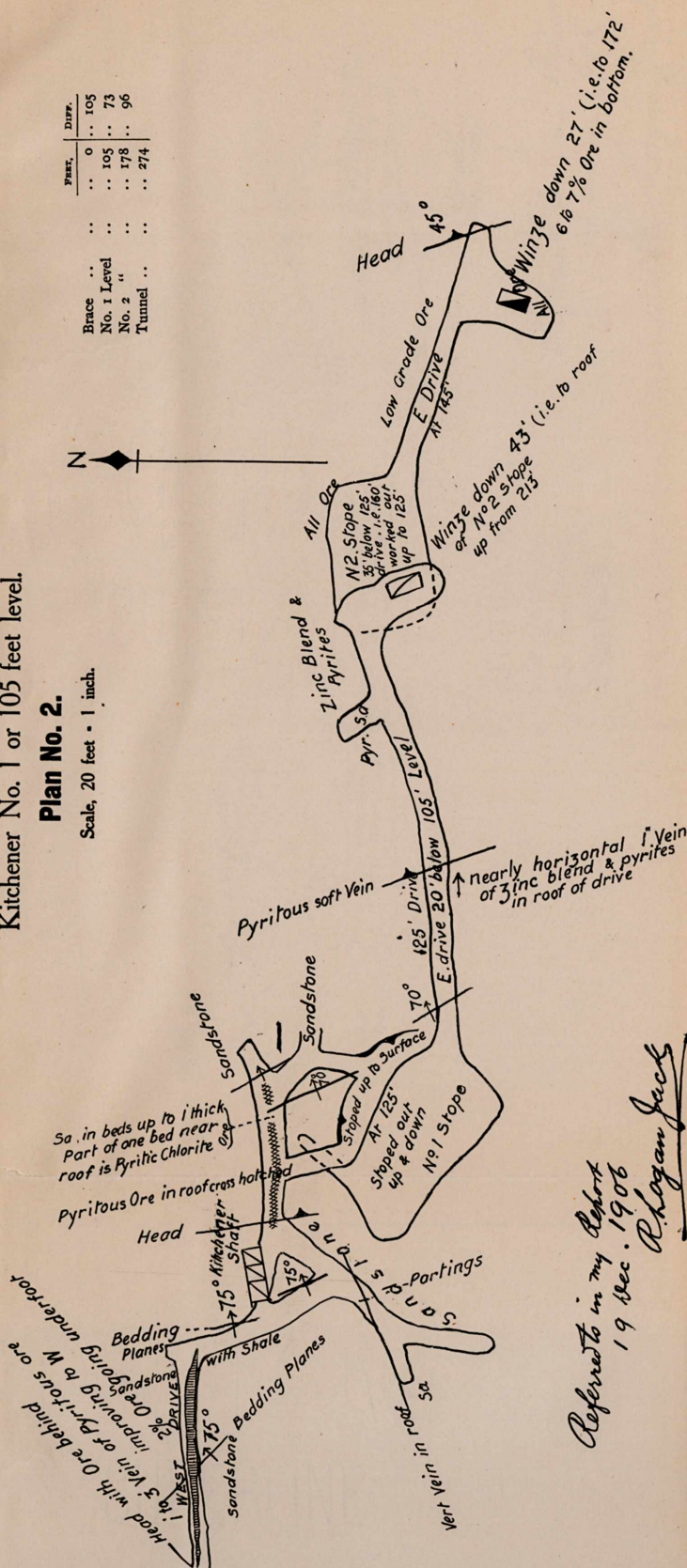
No. 2 Cut.—A trench about 3 chains east of No. 1, and about 30 feet higher, shows a ton or two of ferruginous gossan and brown hæmatite. An assay gave 0.7 per cent. of tin oxide.

S. H. M. & T. Co., Ltd.

Kitchener No. 1 or 105 feet level.

Plan No. 2.

Scale, 20 feet = 1 inch.



Refers to in my Report
19 Dec. 1906
R. Logan Jack

From the observations that have been made, it may be deduced as a law applicable to this region that any fissure may at any moment become a vein carrying oxide of tin. There is every reason to believe that the production of tin ore and the process of chloritization are closely connected.

The shoots of tin ore are, as a rule, not very long horizontally, but of considerable length from top to bottom.

Some of the principal mines follow more or less the strike of the sedimentary rocks, for example, the Ivanhoe and Extended. Others, such as the Kitchener, Monarch, and Eclipse, may be regarded as cross-lodes.

The most important ore deposits are not, however, lodes in the ordinary sense of the term, but huge pipes where ore has, so to speak, leaked from fissures and impregnated the adjacent country rock. Wherever this occurs, it may be assumed that tin in solution, circulating through the fissures, met with a stratum favorable to its deposition, or containing soluble minerals liable to be replaced by tin. From this a rule may be deduced: Expect an "impregnation" ore body, met with on a fissure, to continue down the dip of the stratum in which it occurs.

In the preceding pages, and burdened, it must be confessed, with a large amount of detail, will be found some suggestions on matters of policy. The detail, tedious as it may be to the general reader, may prove of some service to the Directorate or Management. The principal suggestions may be succinctly recapitulated.

Kitchener.—Continue "Kitchener Branch" of tunnel to east to make certain that the whole length of the "tunnel stope" ore body has been seen. Continue the northward drive from the "Kitchener Branch Tunnel" for about 10 feet, to see if the ore body of No. 1 stope does not come down to the tunnel level. Follow the ore just struck in the "West Drive" of No. 1 level.

Extended.—Explore further horizontally and vertically on the long S.E. lode in No. 2 level. Should "Shanahan's Lode" be cut in the extension of the tunnels, follow it as far as it can be traced.

Kitchener and Extended.—Connect the Extended and Black Rock Tunnels and follow any ore that may be cut (the extension has just been commenced).

Ivanhoe.—Extend Tramway Adit and sink No. 2 Ivanhoe Shaft to it. Follow the seam running N. 28° W. in No. 2 level in search of long shoot worked at No. 5 level. Continue No. 6 level for 175 feet further. Follow the fault-lode in "West Drive" of No. 5 level from 320 feet down to 386 feet (No. 6 level), and drive on level to Monarch Shaft. Sink the Monarch 237 feet to connect with level. Extend No. 3 level.

Eclipse.—Connect north drive at 106 feet level with Ladysmith Shaft. Prove at the 151 feet level the horizontal extent and downward trend of the ore body recently met with, and which I believe to be the same that was worked profitably at the 106 feet level. Sink the shaft to the depth of No. 6 Ivanhoe Level and connect. The sinking of this as a Main Shaft for the Eclipse and Ivanhoe Mines (which ought to be one mine) can go on concurrently with the winning of ore from the Ivanhoe.

Stannary Hills Group of Mines Generally.—Employ machine drills operated by compressed air as soon as practicable. (The use of compressed air for pumping I am glad to say, is being abandoned.) Employ diamond drills where possible to save unnecessary driving.

Arbouin.—Instal a diamond drilling plant and drill from the surface at an angle approximately 45 degrees to begin with to locate ore bodies on the "Admiral" zone.

Caledonian.—Sink "Wilesmith's Winze" from the tunnel level for a further 28 feet to the level of the old rich workings, and drive into the latter. Open out on the good ore recently cut in sinking the winze.

It is not to be supposed that the whole of the preceding suggestions can be carried out at once, but they should be acted on as soon as circumstances permit.

As you are aware, the financial position is rapidly improving. Almost all of the recent exploration work has been rewarded with success. Funds are available for the more immediately necessary development, and it must be remembered that the mines must bear the burden of interest on the tramline, the mill, and all other surface works, and must see

something ahead. The following table shows the advance in the monthly output for the last 18 months in tons of black tin, and comment is unnecessary.

MINE.	1905.								1906.											
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.		Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	
Kitchener ..	—	3.75	3.72	18.65	34.45	13.34	4.30		11.24	26.21	13.46	4.03	4.80	32.98	6.61	10.63	17.60	10.90	11.76	
Extended ..	8.90	4.21	8.73	4.63	—	—	—		—	—	0.54	—	—	—	—	—	—	—	—	
Ivanhoe ..	25.54	15.02	26.04	21.24	1.32	10.80	5.52		13.44	9.61	7.92	17.49	28.54	19.61	38.92	35.70	36.35	38.62	55.36	
Ivanhoe No. 2	0.50	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	
Eclipse ..	—	—	—	0.38	—	—	—		—	—	—	—	—	—	—	—	—	—	—	
Arbouin ..	—	—	—	—	1.30	4.37	—		3.90	17.93	22.62	23.61	27.17	26.00	42.50	33.36	32.92	31.64	23.86	
Total Monthly Tonnage ..	34.94	22.98	38.49	44.90	37.07	28.51	9.82		28.58	53.75	44.54	45.13	60.51	78.59	88.03	79.69	86.87	81.16	90.98	

I have only to add, in conclusion, that so far as I can foresee, the Company is entering on a period of prosperity such as it has not yet known.

I have the honor to be,

Gentlemen,

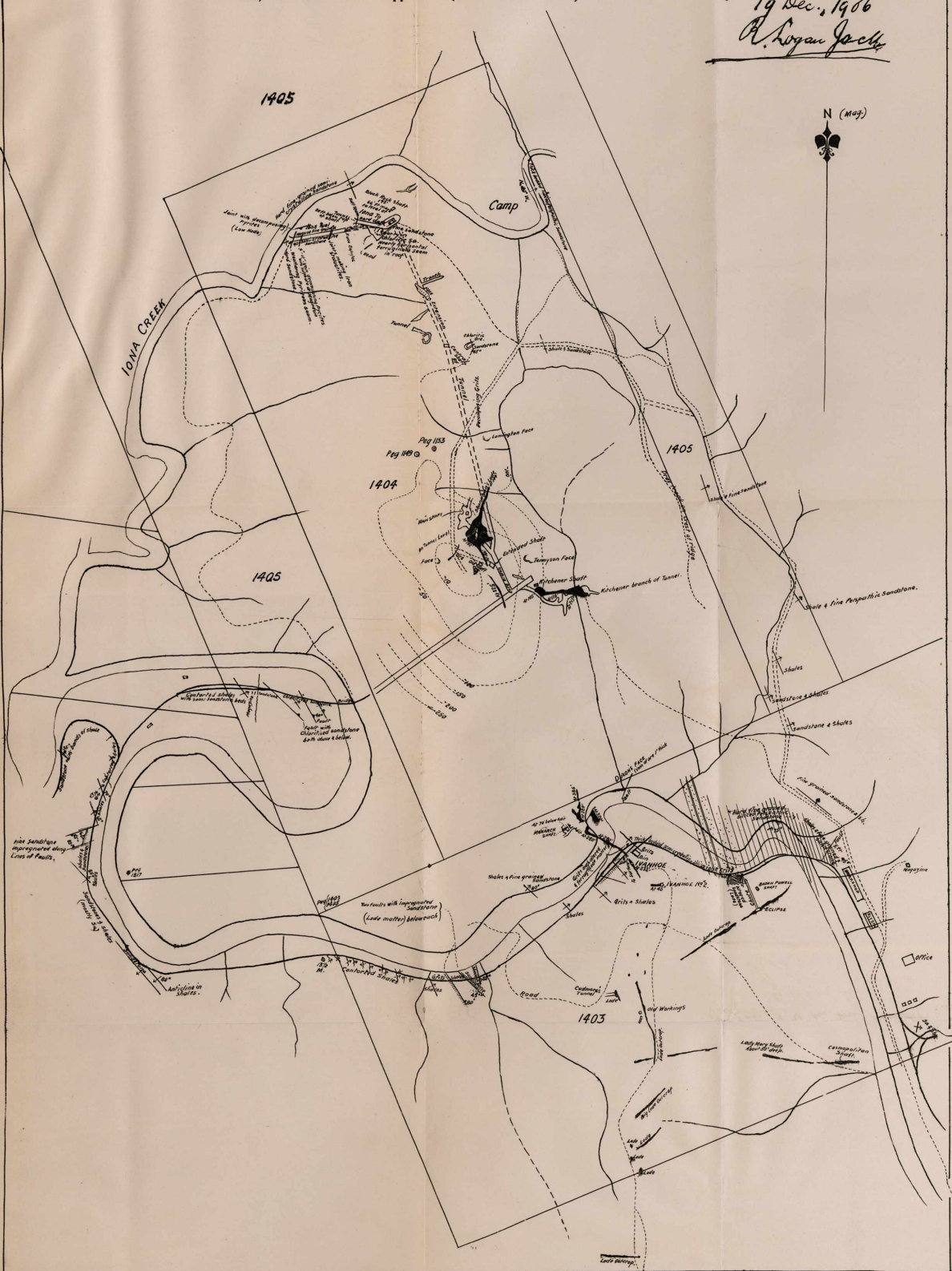
Your obedient servant,

R. LOGAN JACK.

Stannary Hills,
19th December, 1906.

Kitchener, Extended, Monarch, Central,
Black Rock, Ivanhoe, Eclipse, and other mines.

Referred to in my Report
19 Dec., 1906
A. Logan Jacht



Plan No. 6.

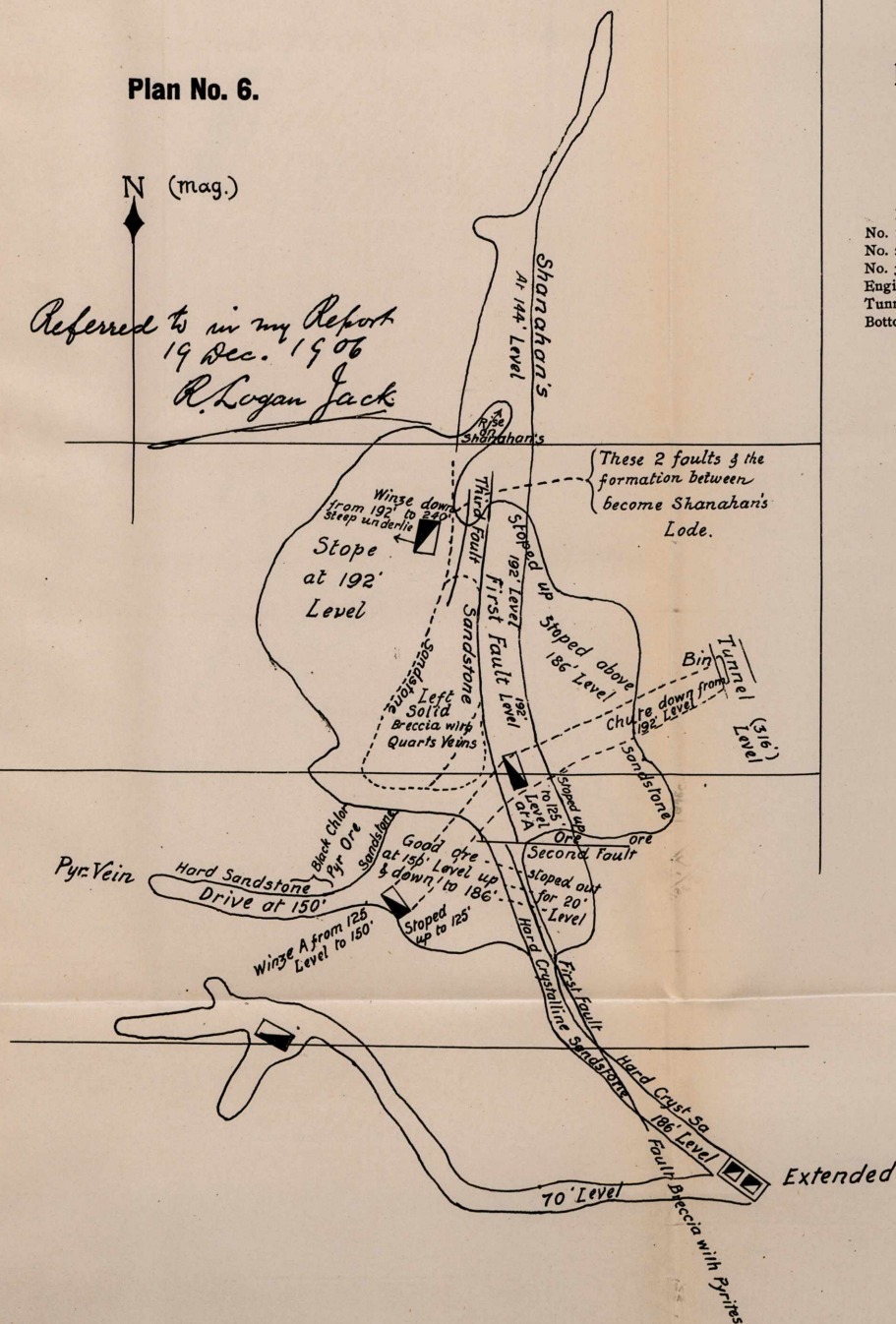
N (mag.)

*Referred to in my Report
19 Dec. 1906
R. Logan Jack*

S. H. M & T. Coy.
No. 3, or 186 ft. level
Extended.

Scale, 20 feet = 1 inch.

	FEET.	DIFF.
Brace ..	0	70
No. 1 or 70 ft. level ..	70	55
No. 2 or 125 ..	125	61
No. 3 or 186 ..	186	88
Engine ..	274	43
Tunnel ..	317	9
Bottom of Main Shaft ..	326	34
" Winze ..	360	



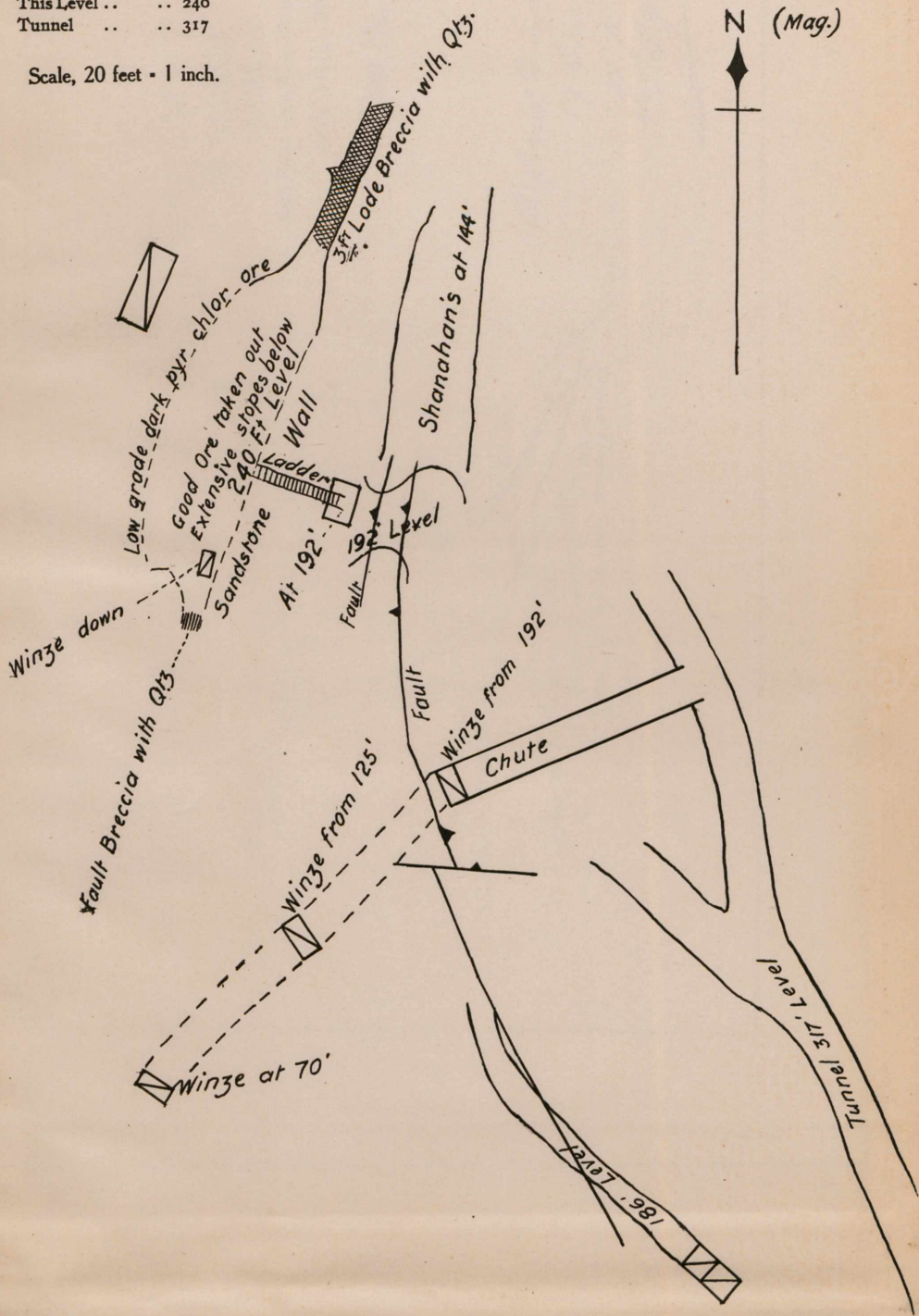
S. H. M. & T. Co., Ltd.
Extended 240 feet level.

Plan No. 7.

	FEET.
Extended Brace ..	0
This Level ..	240
Tunnel ..	317

Scale, 20 feet = 1 inch.

*Referred to in my Report
19 Dec., 1906
R. Hogan Jacks*



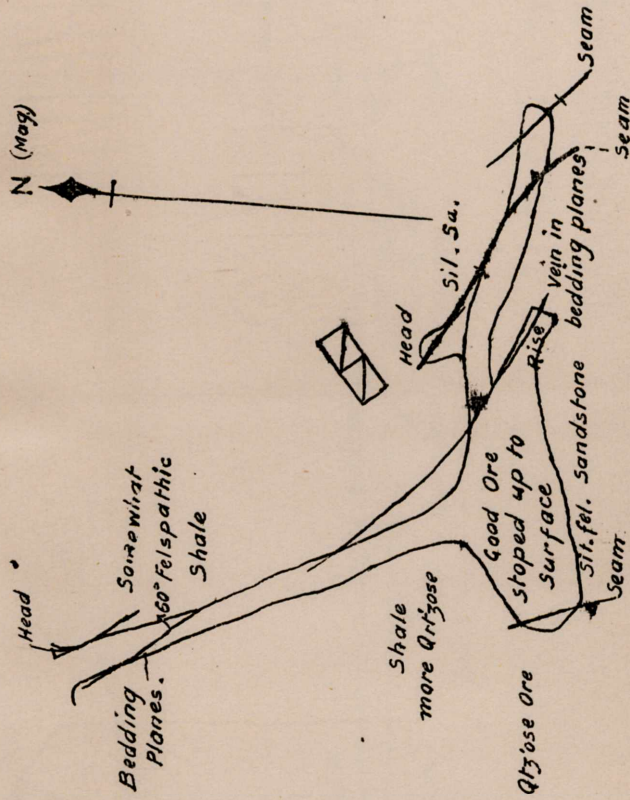
S. H. M & T. Coy., Ltd.
IVANHOE MINE

TRAMWAY ADIT

50 ft. below brace, 42 ft. above Eureka Ck. Adit

Scale, 1 inch = 20 feet.

Plan No. 8.



Referred to in my Report

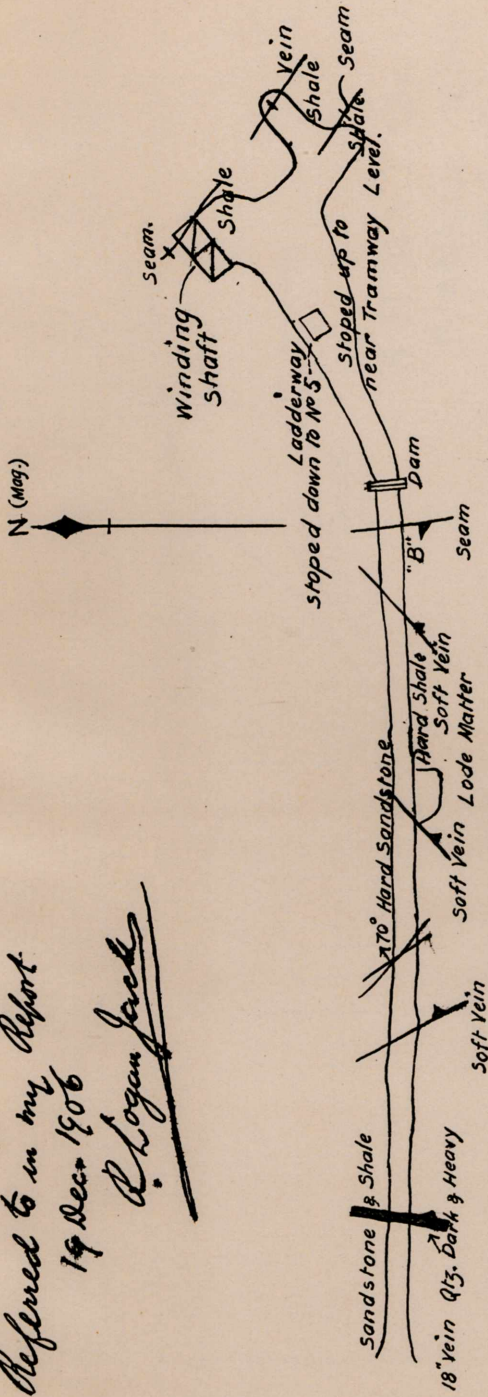
19 Dec., 1906

R. Logan Jack

Referred to in my Report

19 Decr 1906

R. Logan Jacks



S. H. M & T Coy., Ltd.

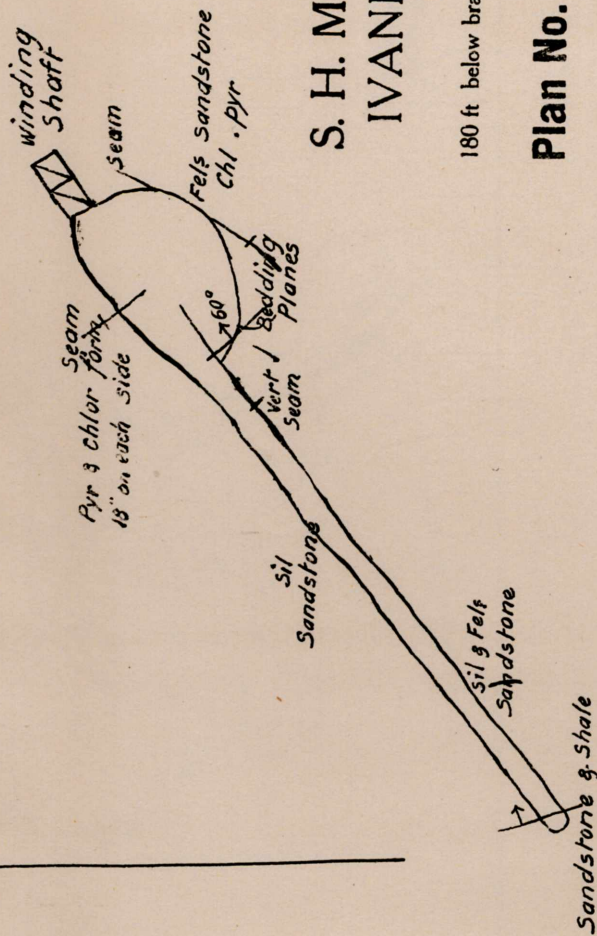
IVANHOE MINE

EUREKA CREEK ADIT

Scale, 1 inch = 20 feet.

Plan No. 9.

N (Mag)



S. H. M & T. Coy., Ltd.
IVANHOE MINE

No. 2 level.

180 ft below brace, 124 ft. below Tramway
Adit.

Plan No. 10.

Referred to in my Report
19 Dec., 1906
A. Lagan Jack

Ivanhoe No 3 Level.

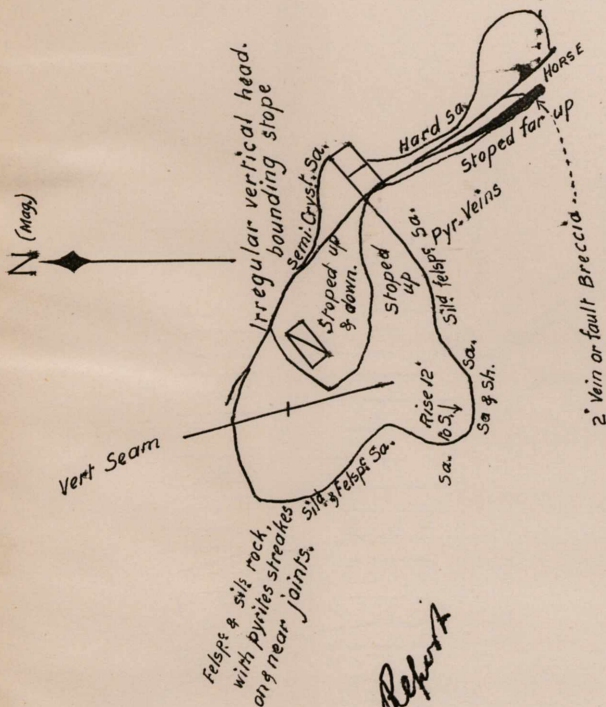
Referred to in my Report
 19 Dec. 1886
 W. H. Logan Jack

S. H. M & T. Coy., Ltd.

Plan No. 11.

233 ft below brace,
 177 ft. below Tramway
 Adit.

Scale, 1 inch = 20 feet.



S. H. M. & T. Co., Ltd.

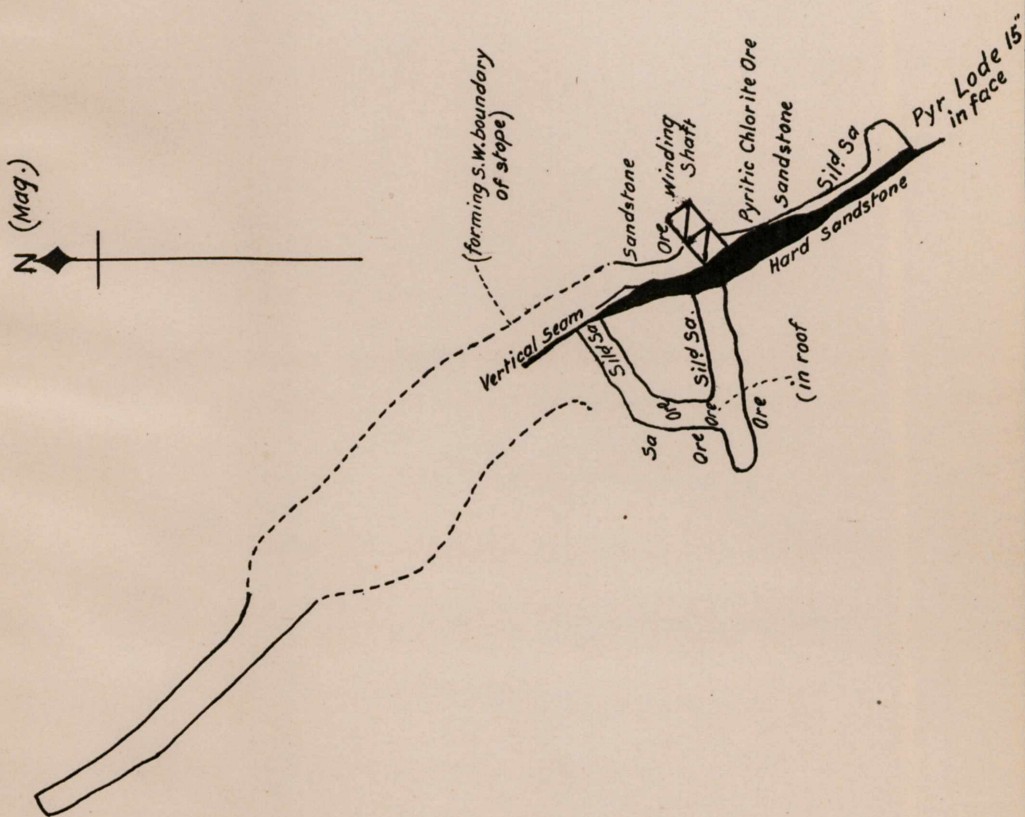
Plan No. 12.

Ivanhoe No. 4 level.

260 feet below Brace.

204 " Tramway Adit.

Scale, 20 feet = 1 inch.



Referred to in my Report
19 Dec., 1906

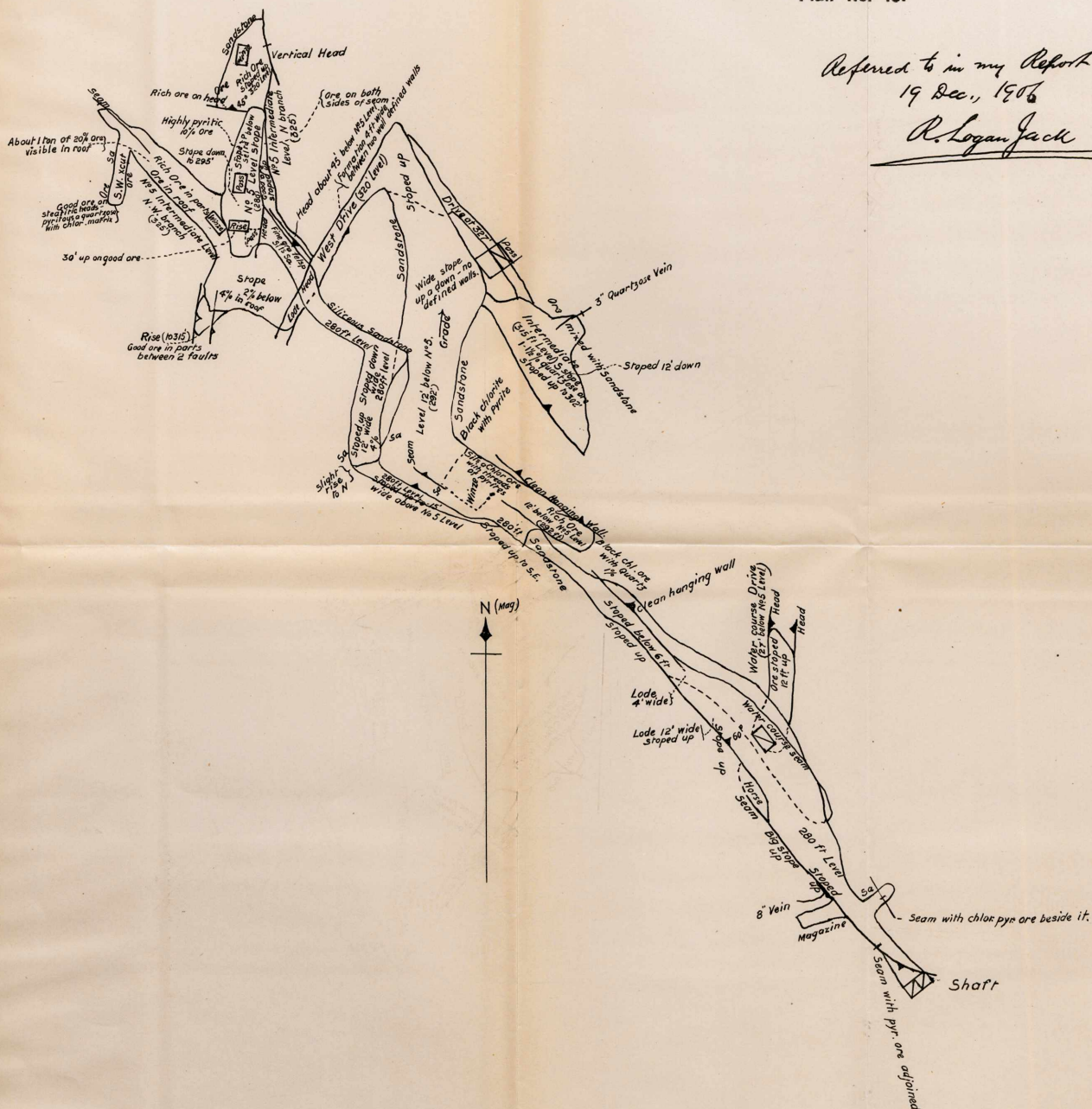
R. Logan Jack

S. H. M. & T. Co., Ltd.
IVANHOE No. 5 level

280 feet below Brace.
224 " Tramway Adit.
Scale, 20 feet = 1 inch.

Plan No. 13.

Referred to in my Report
19 Dec., 1906
R. Logan Jack

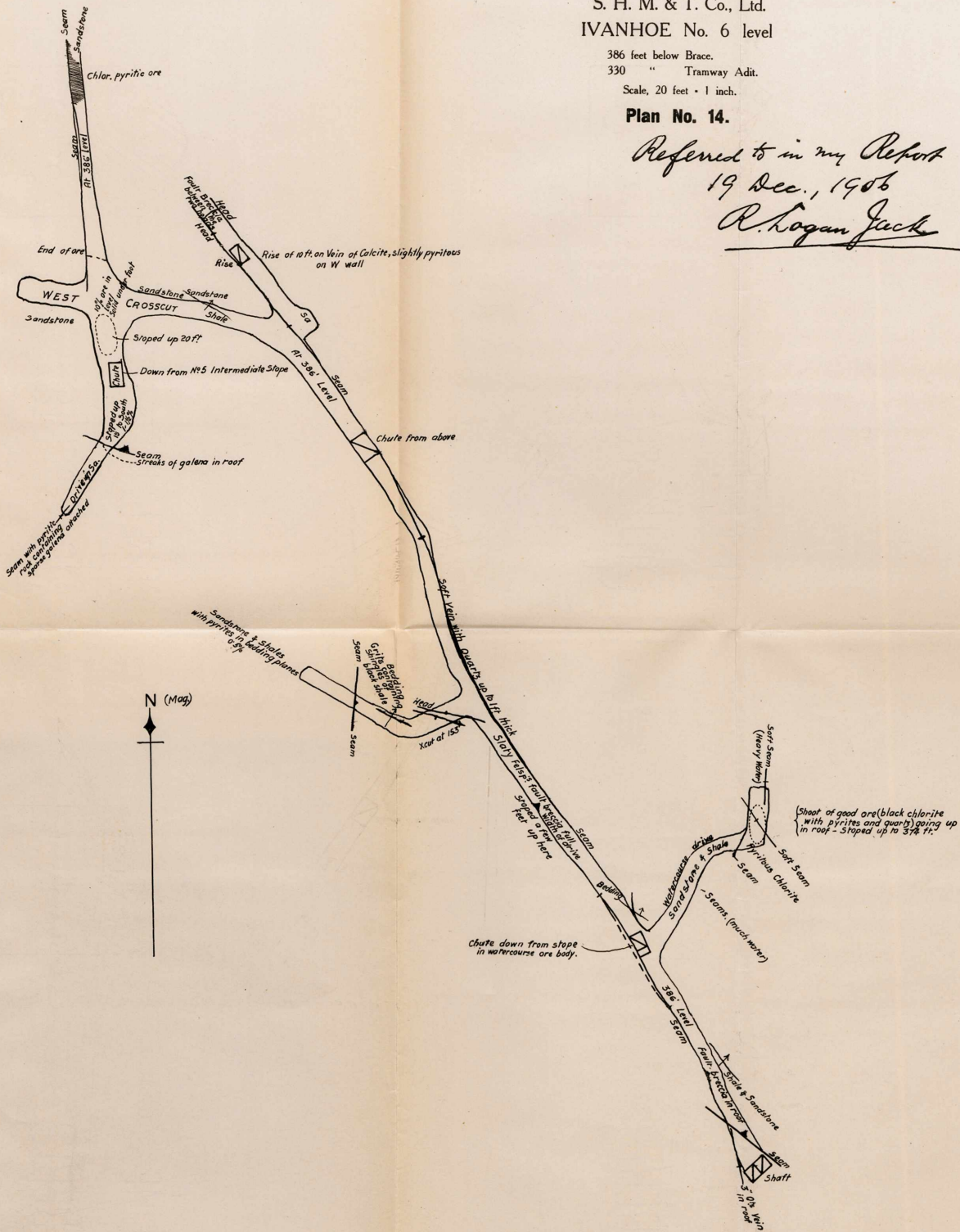


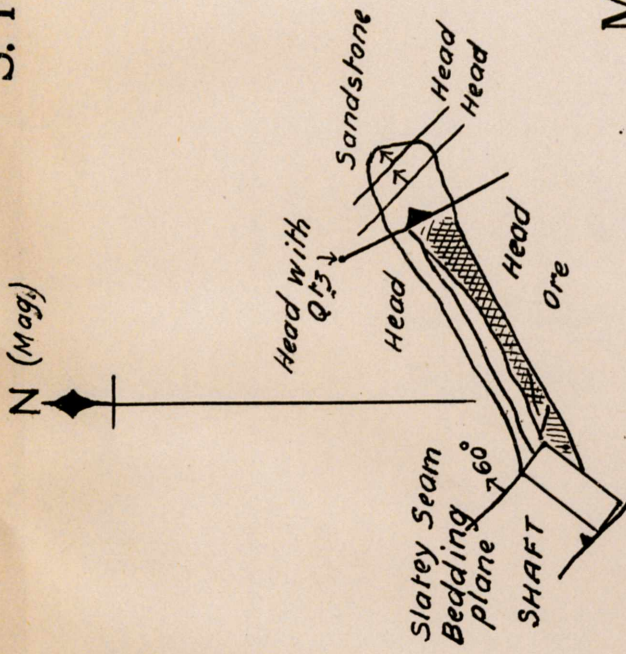
S. H. M. & T. Co., Ltd.
IVANHOE No. 6 level

386 feet below Brace.
330 " Tramway Adit.

Plan No. 14.

Referred to in my Report
19 Dec., 1906
R. Logan Jack





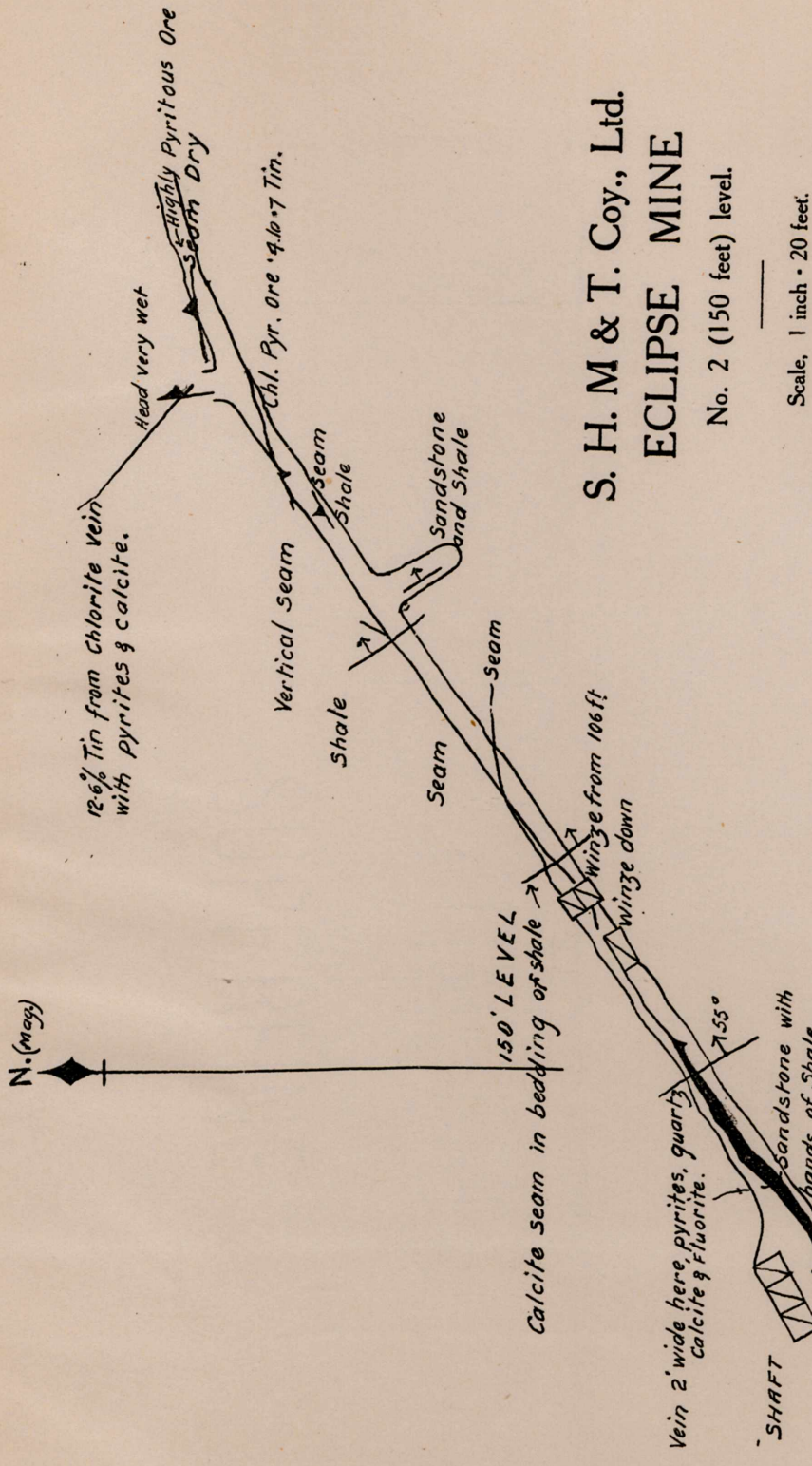
MONARCH MINE

PLAN, 73 FEET LEVEL
73 feet below Adit

Scale, 1 inch = 20 feet.

Plan No. 15.

*Referred to in my Report
19 Dec., 1906
R. Logan Jack*

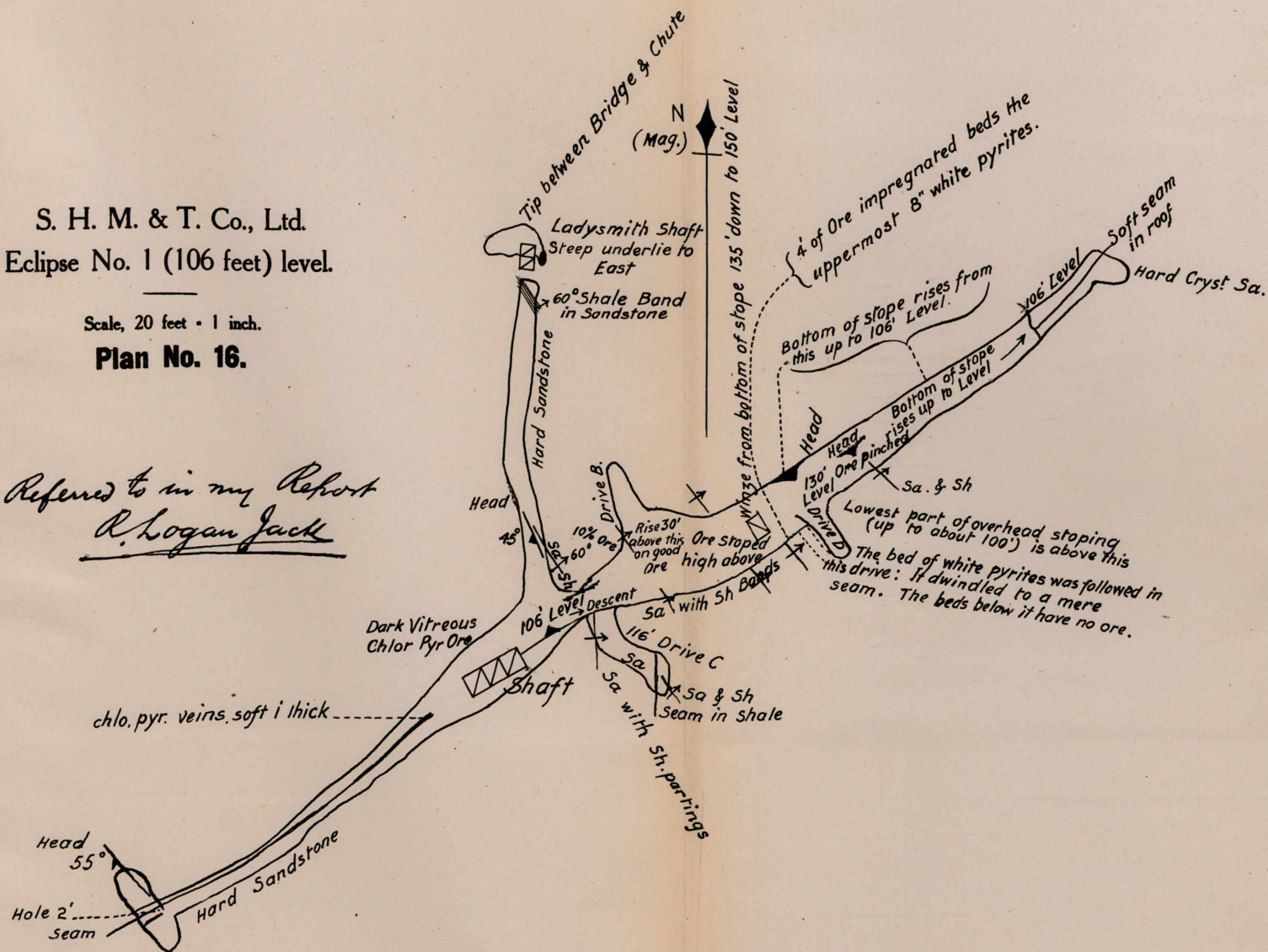


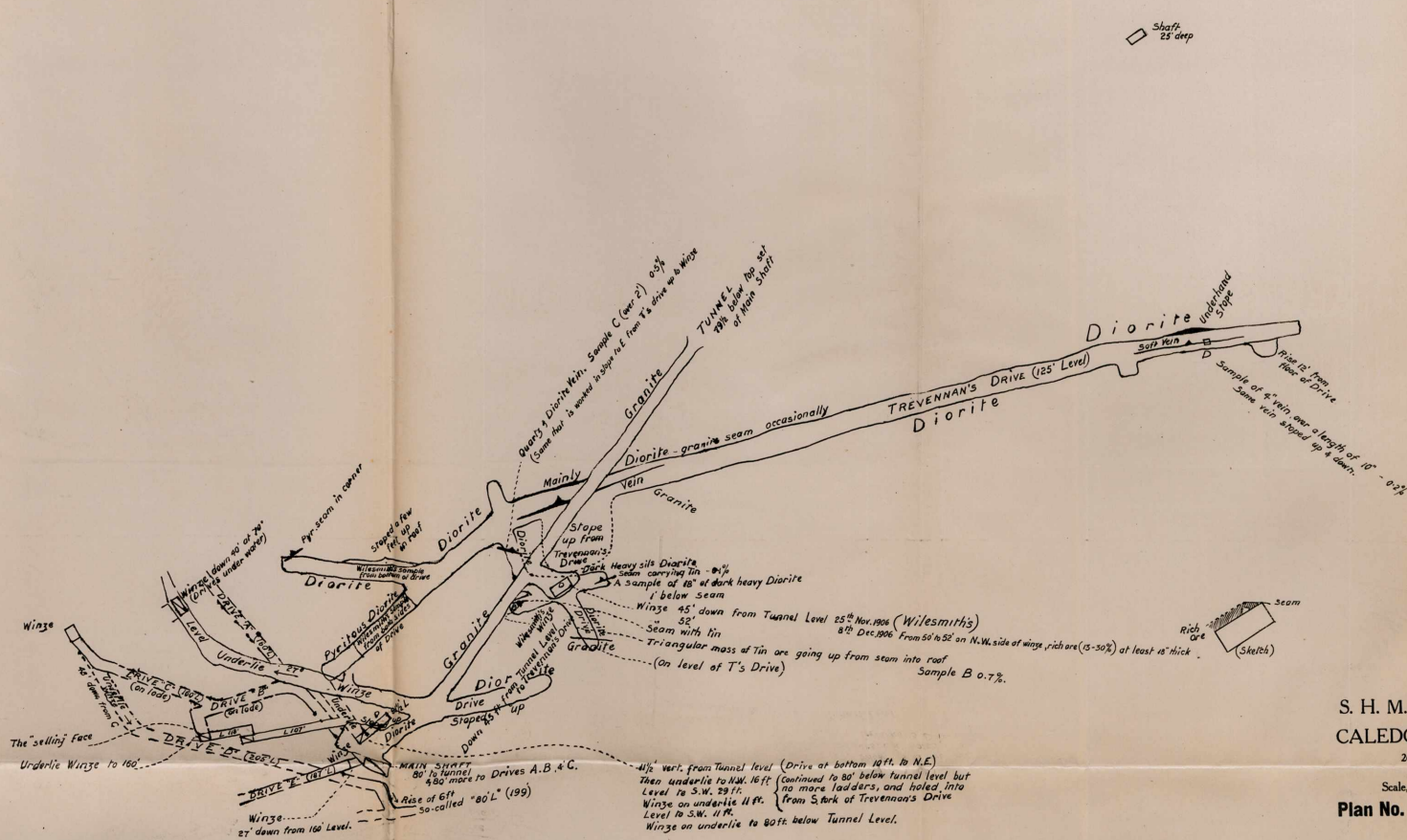
Plan No. 17.

Referred to in my Report
19 Dec. 1906
R. Horgan Jack

Scale, 20 feet = 1 inch.

Referred to in my Report
A. Logan Jack





S. H. M. & T. Co., Ltd.
CALEDONIAN MINE

26 Nov. 1906.

Scale, 20 feet = 1 inch.

Plan No. 18.

Referred to in my Report
19 Dec. 1906
R. Logan Jackson

